

SB761

.U7

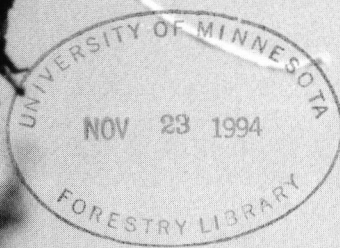
R63

1993

USFS Reg 2

COPY 2

Forest Insect and Disease Conditions in the Rocky Mountain Region 1993



United States
Department of
Agriculture

Renewable
Resources
Forest Health
Management

Rocky
Mountain
Region



**FOREST INSECT AND DISEASE CONDITIONS
IN THE
ROCKY MOUNTAIN REGION
1993**

By
Forest Health Management Group

William H. Blunt, Forest Health Monitoring Coordinator, Ed.

July 1994

Renewable Resources, Forest Health Management
Rocky Mountain Region
USDA Forest Service
P.O. Box 25127
Lakewood, Colorado 80225-5127

ACKNOWLEDGEMENTS

The Forest Health Management (FHM) Staff of the Renewable Resources Unit extends appreciation to all cooperators who contributed to this report.

Information on specific pest problems may be obtained from the Regional Office (303 275-5061), Lakewood Service Center (303 236-9541), Gunnison Service Center (303 641-0471), or Rapid City Service Center (605 394-1960), as well as from the following State Foresters:

COLORADO Jim Hubbard, State Forester
Colorado State Forest Service
Forestry Building
Colorado State University
Fort Collins, CO 80523
Phone: 303 491-6303 FAX: 303 491-7736

KANSAS Raymond G. Aslin, State Forester
Kansas State Division of Forestry
2610 Claflin Road
Manhattan, KS 66502
Phone: 913 537-7050 FAX: 913 539-9584

SOUTH DAKOTA Frank Davis, Director
Division of Forestry
1429 East Sioux Avenue
Pierre, SD 57501
Phone: 605 773-3594 FAX: 605 773-5926

NEBRASKA Dr. Gary L. Hergenrader, State Forester
Department of Forestry, Fisheries and Wildlife
Institute of Agriculture and Natural Resources
Room 101, Plant Industry Building
East Campus, University of Nebraska
Lincoln, NE 68583-0814
Phone: 402 472-2944 FAX: 402 472-2964

WYOMING Mike Gagen, State Forester
Wyoming State Forestry Division
1100 West 22nd Street
Cheyenne, WY 82002
Phone: 307 777-7586 FAX: 307 637-8726

COVER: Juvenile goshawk, *Accipiter gentilis*
Lodgepole pine tree killed by dwarf mistletoe, *Arceuthobium americanum*. Deformed branches and brooms caused by mistletoe may provide habitat for a variety of bird species.

PHOTOGRAPHER: Bill Blunt - Denver, Colorado

MAILING LIST UPDATE - Annual Report 1993

Annually, we update our mailing list. If you have had an address change or would like to receive publications other than what you currently receive, please note the change and return this sheet to the P.O. Box Mailing Address listed below.

Old Name and Address:

Changed/New Name or Address:

Check which mailing(s) you wish to receive:

- ☐ Entomology (Evaluations and Technical Reports)
- ☐ Pathology (Evaluations and Technical Reports)
- ☐ Annual Reports (only)
- ☐ All FHM Reports

NOTE:

P.O. Box Mailing Address:

Renewable Resources - FHM
Rocky Mountain Region
USDA Forest Service
P.O. Box 25127
Lakewood, CO 80225-5127

Building Address:

Renewable Resources - FHM
Rocky Mountain Region
USDA Forest Service
740 Simms Street
Golden, CO 80401

TABLE OF CONTENTS

	PAGE
Acknowledgements	i
Mailing List Update	ii
Table of Contents	iii-iv
Introduction	1
Forest Health Management Organization	2
Forest Health Management Service Centers	3
Rocky Mountain Region Forest Health Management Zones	4
Forest Health Management Workshops and Training	5
International Forestry	5-6
Landscape Disturbance and Forest Plan Revisions	7
Black Hills National Forest	7
Insects--Historical Perspective	7-8
Major Insect Pests in the Black Hills	9-11
Endangered and Sensitive Insects and Snails	12
Exotic Insects Introduced to the Black Hills Area	13
Exotic Species Known to be Established	13
Exotic Species Likely to be Established	13-14
Species and Circumstances of Concern	14
Exotic Agricultural Pests and Releases of Their Natural Enemies	14
Limits of Information	14
Exotic Species Released As Biological Control Agents Against Rangeland Weeds	15
Black Hills National Forest	16
Diseases--Historical Perspective	16
Major Plant Diseases in the Black Hills	17-20
Diseases Introduced to the Black Hills	20
Effects of Management Relative to Insects and Diseases	20-22

TABLE OF CONTENTS

	PAGE
Summary of Insect and Disease Conditions Rocky Mountain Region	23-25
Rocky Mountain Region Insects	26-32
Rocky Mountain Region Diseases	33-43
Pesticide Use in Region 2 in FY 93	44-45
Herbicide Use In Region 2	46
Federal Certified Applicator Report	47
Recent Publications	48

INTRODUCTION

Forest Health Management (FHM) is responsible for the detection, evaluation, and suppression of insects and diseases on forested Federal lands. FHM also administers financial and technical assistance programs with the State Foresters of Colorado, Kansas, Nebraska, South Dakota, and Wyoming. In addition, the management of Gypsy Moth is a shared responsibility with the Animal and Plant Health Inspection Service (APHIS). APHIS also has the responsibility for the range pest management programs on Federal lands. Close coordination and cooperation of the Federal and State Agencies responsible for pest management is necessary as several land ownerships are involved.

FOREST HEALTH MANAGEMENT SERVICE CENTERS

Three Service Centers serve the Rocky Mountain Region. These were established to provide timely and effective pest management services to their customers. Questions concerning Center operations and requests for service can be directed to the Forest Health Management (FHM) Group Leader, in the Regional Office or the respective Service Center Leaders.

The **Lakewood Service Center (LSC)** in Building 20 on the Denver Federal Center provides assistance to Kansas, eastern and northwestern Colorado, and southern Wyoming. This includes the following National Forests and cooperators in adjacent areas:

Pike & San Isabel (except Leadville, Salida and San Carlos Ranger Districts)
Arapaho & Roosevelt
Routt
Medicine Bow
White River (Dillon Ranger only)

Dave Johnson, Supervisory Plant Pathologist, serves as the Service Center Leader. Ken Lister and Mike Sharon are the Center's Entomologist and Plant Pathologist, respectively.

The **Gunnison Service Center (GSC)** is located at 216 North Colorado, Gunnison, Colorado 81230. It provides assistance to the following National Forests and cooperators west of the Continental Divide in Colorado:

Rio Grande
Pike & San Isabel (Leadville, Salida and San Carlos Ranger Districts)
San Juan
Grand Mesa, Uncompahgre & Gunnison
White River (except the Dillon Ranger District)

Bernie Raimo is Supervisory Entomologist and Service Center Leader. Pete Angwin is the Plant Pathologist and Tom Eager is the Center's Pest Management Specialist.

The **Rapid City Service Center (RCSC)** is co-located with the Rocky Mountain Forest and Range Experiment Station at the Forestry Sciences Lab, South Dakota School of Mines and Technology, 501 E. St. Joe, Rapid City, South Dakota 57701. The Service Center provides assistance to the following National Forests and cooperators east of the Continental Divide in northern Wyoming, and in South Dakota and Nebraska within Region 2:

Black Hills
Bighorn
Shoshone
Nebraska

Judy Pasek is Supervisory Entomologist and Service Center Leader, Bill Schaupp is the Center's Pest Management Specialist, and Jeri Lyn Harris is the Plant Pathologist.

The FHM staff in the Regional Office, located at 740 Simms Street, Golden, Colorado, provides assistance to the three Service Centers. Robert Averill is the Group Leader; Laura Disbrow is Systems Analyst; Susan Johnson, Biologist, handles special projects such as Cinara; Bernard Benton, Computer Specialist, provides assistance with data entry and testing. Bill Blunt is Forest Health Monitoring Coordinator for the Rocky Mountain Region.

Forest Health Management Organization

Rocky Mountain Region

GLEN HETZEL
DIRECTOR
Renewable Resources

Bernie Raimo
Gunnison Serv.Center
Center Leader

Judy Pasek
Rapid City Serv.Center
Center Leader

Jeri Lyn Harris
Rapid City Serv.Center
Plant Pathologist

Bill Schaupp
Rapid City Serv.Center
Pest Management Spec.

Bernard Benton
Regional Office
Computer Spec.

Laura Disbrow
Regional Office
Systems Analyst

Bill Blunt
Regional Office
FHM Coordinator

Susan J. Johnson
Regional Office
Biologist

Mike Sharon
Lakewood Serv.Center
Plant Pathologist

Ken Lister
Lakewood Serv.Center
Entomologist

Dave Johnson
Lakewood Serv.Center
Center Leader

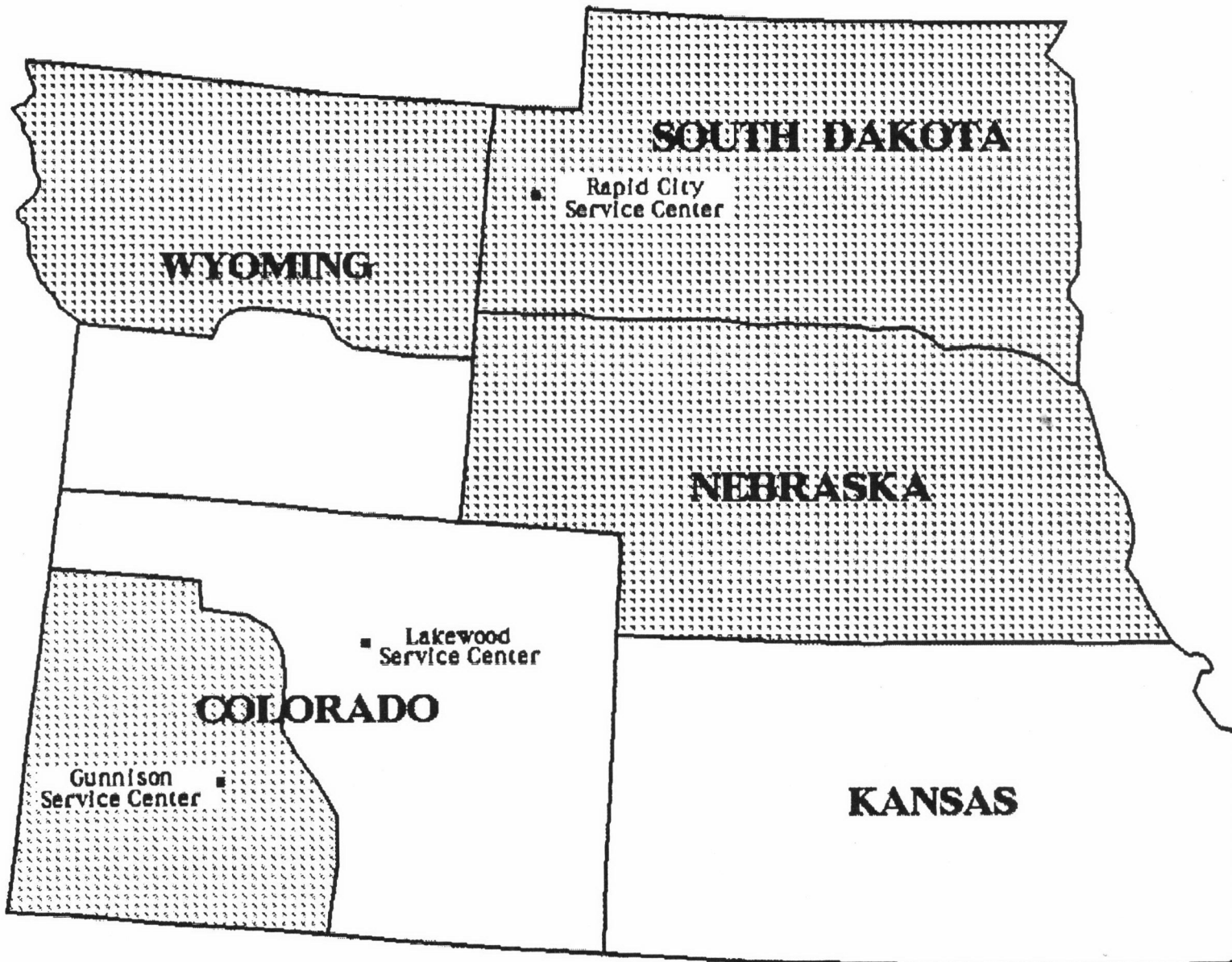
Tom Eager
Gunnison Serv.Center
Entomologist

Pete Angwin
Gunnison Serv.Center
Plant Pathologist

Robert Averill
Regional Office
FHM Group Leader

ROCKY MOUNTAIN REGION

Forest Health Management Zones



FOREST HEALTH MANAGEMENT WORKSHOPS AND TRAINING

Rapid City Service Center staff taught the insect and disease sections of a new Natural Resources Techniques and Measurements course offered at Black Hills State University during spring semester 1993. This course was sponsored and coordinated by the Rocky Mountain Forest and Range Experiment Station and the Rocky Mountain Region of the Forest Service as part of the Native American Program to help students qualify for Forest Service positions by adding field-oriented coursework to the biology curriculum.

A workshop on Landscape Disturbance was sponsored by the Rocky Mountain Interagency Prescribed Fire Working Group, Forest Health Management (USDA Forest Service), and Colorado State University. It was designed to provide information to those making decisions or recommendations concerning ecological disturbances. During the conference, the Forest Health Management staff of the Gunnison Service Center coordinated and led a field trip to view insect and disease impacts in the Taylor Park and Taylor Canyon areas. The workshop was held in Gunnison, Colorado, November 2-5, 1993, and was attended by 45 participants representing National Forests, Bureau of Land Management, National Park Service, Curecanti National Monument (NPS), US Fish and Wildlife Service, Intermountain Fire Science Laboratory, Colorado State University, USFS Rocky Mountain Forest and Range Experiment Station, USFS Washington Office, and Colorado Environmental Coalition.

Hazard tree workshops were presented at the National Arbor Day Institute and on the Routt National Forest. Forty-five people in private practice or working for cities or state agencies learned about risk, reason, and common sense in evaluating trees for hazard. Seven people attended a national forest session. The strongest interest continues to be within urban forestry. Educational efforts on hazard tree risks on all public lands need to be increased.

INTERNATIONAL FORESTRY

Aphids In Africa

The Forest Service was requested to assist the International Institute of Biological Control (IIBC) in a study of the insect natural enemies of North American *Cinara* aphids. An outbreak of the cypress aphid, *Cinara cupressi* Buckton (Homoptera, Aphididae), an introduced pest of Cupressaceae in Africa, has resulted in an international effort to develop suitable biological control techniques for its management. Several other aphids are also becoming a problem. Annual growth loss in cypress, by *Cinara* alone, has been estimated at 17.5 million dollars to the countries affected. Cypress trees are used for ornamentals, building material, fire fuel, as well as living fences. In Kenya, the total potential loss in cypress, over a period of years, is equivalent to one billion dollars in U.S. currency.

Robert Averill, Group Leader, FHM, and Dan Kucera, Entomologist, Northeastern Area, visited the IIBC in England in 1992, to become acquainted with the international protocols associated with biological control. Surveys were made in southwest England to become familiar with the aphids' biology and ecology in England. They also visited the IIBC lab in Delemont, Switzerland, where the majority of the coordination for the international effort in biological control of noxious weeds is initiated. Their visit was completed with a trip to the Food and Agricultural Organization (FAO) headquarters in Rome, Italy, to be briefed on the African aphid project goals. Sean Murphy with IIBC in London visited Colorado in 1992 and 1993, to learn about the biology and ecology of *Cinara* species in Colorado and to facilitate parasite collections for shipment to England.

Surveys throughout North America to find suitable parasites resulted in determining that Colorado may provide the best possible candidate parasite species for eventual introduction into Africa. Susan Johnson, FHM in the Rocky Mountain Regional Office, is in charge of the collection activity in Colorado. Aphids that were mummified and those appearing to have the potential to become mummified were shipped to IIBC in England during the field seasons of 1992 and 1993. Shipments in 1993 consisted of 137 mummies and 5 syrphid larvae. At the present time, none of the parasites from the Colorado material have crossed-over to parasitize the Kenyan *Cinara cupressi*. Taxo-

nomic work on the *Cinaras* was completed from the '93 field season. *Cinara cupressi-sabinae* occurs at all the Colorado sites as the sole inhabitant, except in Big Thompson Canyon where *Cinara cupressi-sabinae* lives with *Cinara* sp. taxon D. The western slope and southern Colorado is where *Cinara* sp. taxon D. is predominately found on *Juniperus monosperma* and *utahensis*. Further screening of the dipteran predator (Chamaemyiid) and other potential

predators will be done with the eventual goal of establishing one or more species in Kenya to help control the aphid problem. Collection of specimens is scheduled to continue in Colorado during the summer of 1994.

LANDSCAPE DISTURBANCE AND FOREST PLAN REVISIONS

Insects and diseases and other invertebrates play important roles in the ecological functioning of habitats, and are comprised of several thousand species. Land managers are usually most concerned with the few species that are considered to be pests. A pest can be defined as an organism that causes unacceptable, adverse effects on plant or animal species or communities of interest. In other words, the pest status of a particular organism is dependent largely on human and economic values, the extent and intensity of damage, and the particular habitat affected and its intended use(s). For example, an outbreak of a particular tree-killing insect species may be considered a pest in a stand managed primarily for fiber production, but be regarded as largely beneficial in a special wildlife emphasis or wilderness area.

Population levels of insects and other invertebrates and severity of diseases are affected by a number of environmental conditions, both abiotic and biotic, and by natural events and human activities. Insects and diseases can build to epidemic proportions when favorable conditions exist. Forest Health Management is a philosophy important to land management, that relies on use of the best combination of available methodologies for a particular setting for prevention, suppression, and monitoring of pest populations. In many cases, the best preventative actions can be taken during vegetative management activities, such as silvicultural thinning and harvesting, to meet a variety of forest management objectives.

A variety of insects and other invertebrates as well as vertebrates may also become a concern to managers when they become rare, sensitive, threatened, or endangered for a variety of reasons. In such cases, special considerations may be necessary in order to conserve these species and provide suitable habitat for viable populations.

Management alternatives that change the mix of age classes and densities of forest stands will have effects upon the insect and disease components of forested environments. Insects and diseases are a major consideration in forest plan revision topics concerned with biological diversity, lands suitable for tree harvest, as well as lands not suitable for tree harvest. They may also indirectly affect water yields through reductions in vegetative cover.

The FHM Service Centers are currently providing assistance with National Forest Resource Management Plan revisions. GSC is working with the Rio Grande and White River, LSC with Arapaho/Roosevelt and Routt, and RCSC with the Black Hills.

The Black Hills National Forest Resource Management Plan is the initial plan in the revision process in the Rocky Mountain Region. The Forest Health Management information gathered in conjunction with the Forest Plan revision effort sets the stage for future management of this land area. The insect and disease information is vital for Resource Managers to evaluate alternatives and the risks associated with a particular management decision. It is being featured in this publication as an example of insect and disease documentation associated with Forest Plan revisions.

BLACK HILLS NATIONAL FOREST

Insects--Historical Perspective

Historically, insects and other invertebrates have played large ecological roles in the Black Hills. They far surpass other animals in numbers and species and can be found in all habitats. Insects and other invertebrates play important functions as decomposers, nutrient recyclers, food sources for wildlife and fish, pollinators, and natural enemies of other organisms. To many, however, certain insect and other invertebrate species are considered pests. Although there may be many thousands of species of insects in the Black Hills, only several hundred may be considered pests, and just a few of these are considered to be major pests of plants or animals. For instance, some insects destroy live stands of trees, which can reduce timber-harvest potential. As well, insect infestations appear unsightly to many people or may be a nuisance. Most other invertebrate species are largely considered to be innocuous or beneficial, with the exception of a few pests, such as ticks and biting spiders.

In forests, insects often are most destructive when trees are already weakened by overcrowding, fire, drought, disease, injury, or other agents. These weakened trees become less resistant to insect infestations, enabling populations to build up in them.

Pleistocene to 1874: Little is known pertaining to insects and diseases in the Black Hills prior to historical records beginning in the late 1800's. Most present-day native species or their ancestors likely existed for centuries and evolved along with changes in plant communities and physical environments.

1875 to 1899: The mountain pine beetle is a native insect that likely has existed in the Black Hills for hundreds of years, if not longer. The first recorded epidemic began in 1885 and a species description of what was then called the Black Hills beetle was first published in 1909 by Hopkins.

1900 to 1983: Thompson (1975) reviewed insect activity in the Black Hills from 1895 to 1974. Reports describe periodic, widespread epidemics of mountain pine beetle, the first and most devastating observed from 1885 to 1908, which killed an estimated 1-2 billion board feet of ponderosa pine in patches scattered across virtually all of the unharvested forested area. Subsequently, four major outbreaks, each lasting 8-13 years, has occurred with peak damage occurring in 1939, 1949, 1963, and 1974 (Lessard 1986). Each succeeding major outbreak was increasingly severe; from 1969-1981, 200-300 million board feet was destroyed. Smaller outbreaks that were limited geographically frequently occurred between major epidemics. About every third outbreak has been a major epidemic causing tree mortality on a scale similar to those occurring in 1895-1908 and in 1969-1981 (Lessard 1984).

Harvesting and thinning have been the primary methods of dealing with mountain pine beetle infestations since the beginning of the century. Control work was reduced from 1942 to 1946, because of World War II, and by 1946 epidemics were again building and control measures were needed. Large spray programs also were used in addition to harvest activities from the late 1940's through the 1960's. In the 1970's, the Black Hills National Forest undertook a large-scale effort to thin stands across the northern hills in hopes of reducing susceptibility of pine stands to attack.

Secondary insect pests were abundant enough to be of particular note in reports during a few time periods (Thompson 1975). The presence of other pine bark beetles, including *Ips* spp., red turpentine beetle, *Hylurgops* spp., and *Orthotomicus* sp., were noted in 1902 in conjunction with the mountain pine beetle epidemic and following the 1890-1900 drought. From

1933 to 1938, during a severe drought period, a number of insect pests became abundant or epidemic, including *Ips*, pine sawflies, *Rhyacionia* spp. pine tip moths, pine needle scale, red turpentine beetle, birch skeletonizers, and webworms. *Ips* again became abundant in 1964, a year with below normal precipitation and near the end of another major MPB outbreak. High populations of *Ips* and red turpentine beetle in these reported time periods were related to logging activity or to trees damaged by storms. A *Chrysomela* leaf beetle reportedly defoliated aspen and birch in 1963 and 1967, and the spear-marked black moth caused heavy defoliation of birch in the northern hills in 1968-1969. Most populations of defoliating pests subside naturally within one to several years.

1983 to 1993: A localized outbreak of mountain pine beetle occurred from about 1988 to 1993 in the Bear Mountain area about 10 miles southwest of Hill City, South Dakota, where planned thinning and harvesting activities had been delayed primarily due to harvest contract defaults. In 1992 and 1993, almost 3,000 acres of pine were treated with sanitation and silvicultural harvest to reduce population levels and damage spread. Smaller pockets of mountain pine beetle activity occurred in adjoining portions of the Forest. In 1989 to 1992, *Ips* and red turpentine populations were again high due to drought stress and storm damage, especially in areas of logging activity. A *Chrysomela* leaf beetle caused noticeable defoliation of aspen in spots in the central and southern hills in 1990. Between 1989 and 1992, high populations of pine sawflies, pine tip moths, and birch skeletonizers generally were attributable to drought influences. Many of these species had or were beginning to decline in response to weather influences during 1992 and 1993.

Major Insect Pests in the Black Hills

The most aggressive and destructive insect in the Black Hills is the mountain pine beetle, *Dendroctonus ponderosae*. It has the potential to kill 80% or more of the pines in susceptible stands through the course of an infestation. Whenever stand structure develops into highly susceptible condition, epidemics of this insect are likely. Such cycles have averaged an 11-year interval in the Black Hills ecosystem over the past 120 years. Major infestations usually last between 8 and 13 years, and can sweep across mountain after mountain.

The mountain pine beetle thrives on ponderosa pine. It is a permanent resident of the Black Hills, always present in at least small pockets throughout the forest. The insect prefers dense pine stands, containing trees between 7 and 13 inches in diameter.

The beetles emerge from previously infested trees in late July or August and fly to attack green trees, where they bore through the bark to feed on living tissue. Resin mixes with sawdust produced as the beetle bores into the tree. A pitch tube is formed in response to the injury by the beetle. The mountain pine beetle emits a chemical that attracts other beetles to join in the attack. This mass attack is necessary in order to overcome the natural defenses of the tree. When a tree reaches its capacity in beetles, the beetle emits another chemical that tells other beetles that the tree is at its maximum capacity. The flying beetles will then find other host trees.

Under the bark, the beetles lay eggs, which hatch into small, grub-like larvae. These larvae dig tunnels horizontally in the tree, effectively girdling it, which contributes to the tree's death. Additionally, the beetle transmits a blue stain fungus that grows through and clogs the conductive tissues in the tree. Although the tree is effectively dead, it will remain green through the winter. Infested pine then turn yellow in the spring, and red in the summer. Whole mountainsides appear to wear a telltale red "sash," though the insects have by then emerged to infest new areas of green pine.

Several species of *Ips* pine engraver beetles show increasing activity during unusually dry years. Their attacks have been scattered on ponderosa pine trees throughout the Black Hills. *Ips* beetles typically attack fresh cull logs and slash, scorched trees, and storm-damaged trees, then move into stressed green trees. This is the second most destructive genus of western bark beetles, right behind *Dendroctonus*. *Ips* typically kill individual trees and small groups of trees, but damage can be more extensive under epidemic conditions.

Ips adults can attack host material from spring through fall and may have as many as four generations per year in the Black Hills. *Ips* can develop from egg to adult in about one month during the warmest part of the year. The short life cycle allows populations to build very rapidly during favorable periods. Beetles can breed in branches as small as 2 inches in diameter. Boring dust accumulates at the point of

attack, but pitch tubes are infrequently formed. Larvae feed in living tissue beneath the bark, which girdles the tree. *Ips* typically attack the tops of living trees first, resulting in a characteristic topkill prior to total death of the tree. *Ips* beetles also carry the blue stain fungus. Trees attacked by *Ips* frequently serve as reservoirs for endemic levels of mountain pine beetle.

The red turpentine beetle, *Dendroctonus valens*, attacks stumps and the bases of weakened, stressed, and dying ponderosa pine trees. Populations occasionally become abundant in areas where trees are damaged by storms, fire, or logging equipment. Although heavy attacks can kill trees, red turpentine beetles normally weaken trees and may make them more susceptible to attack by other organisms. During spring and summer, large, reddish pitch tubes are formed at the point of attack on lower boles. Larvae feed in groups in cavities formed beneath the bark and pupate nearby. Adults and larvae are able to survive winter months. Length of the life cycle varies with climatic conditions.

A number of wood borers (Cerambycidae and Buprestidae) are abundant in the Black Hills. They typically attack dead, dying, and stressed trees but generally are unable to successfully colonize healthy green trees. Pine sawyer (Cerambycidae) adults are strong fliers and can readily locate fire-damaged trees. They commonly colonize pines attacked by bark beetles as well. Larvae begin feeding beneath the bark of trunks and large branches, then tunnel into the sapwood and heartwood. This causes structural defects in wood products. Adults can be a nuisance to users of firewood. Eggs are laid from summer into fall and larvae feed for 1 to 2 years, depending on species.

Another wood borer common in the Black Hills is the bronze birch borer, *Agrilus anxius* (Buprestidae). Beetles attack and kill weakened and injured birch. Damage is especially severe during drought years. Topkill is abundant because beetles prefer to attack small branches first and gradually progress downward through the tree over a period of several years. Development from egg to adult requires 1 to 2 years, depending upon temperatures. Adults emerge from spring through early August and feed on leaves for about 3 weeks before laying eggs in bark crevices. Larvae construct long, winding, shallow galleries between the bark and wood of the stem, branches, and

occasionally the roots of host trees. Larvae and pupae overwinter within the tree.

The twolined chestnut borer, *Agilus bilineatus*, has become abundant on bur oaks in the Black Hills in recent years. Trees weakened by drought, defoliation, and disease are usually attacked. Attacks begin in the tops of trees and progress downward as the trees weaken further. Topkill and branch mortality is common, and sometimes entire trees are killed. In early spring, larvae pupate, then emerge as adults. Eggs are deposited on bark in late spring or early summer. Larvae bore through the bark and begin excavating winding tunnels in the inner bark and outer wood of large branches and the main trunk. Mature larvae overwinter in pupal cells in the tree.

The western pine tip moth, *Rhyacionia bushnelli*, is a common shoot borer in ponderosa pine and is especially abundant on seedlings and small trees in the southern and central hills. Larvae mine needles, buds, and shoots, killing shoots and stunting tree growth. Attacks on the terminal shoot cause forked or deformed growth. Adults emerge in spring and lay eggs on needles and shoots. Larvae feed through mid-summer and summer generations pupate within the dead, hollowed-out buds. Two or three generations per year may be produced depending on weather conditions. The final generation pupates in the soil, where it overwinters.

In recent years, small numbers of the gypsy moth, *Lymantria dispar*, have been found in several locations within the Black Hills. The gypsy moth, which has so devastated trees in New England and the Great Lakes states, has likely been transported into this region as egg masses or pupae attached to vehicles and personal belongings of people travelling or moving here from generally infested areas. Most introductions of gypsy moth to the Black Hills appear to have been isolated individuals; however, one localized population was eradicated in the early 1980's, and adults have been caught for several consecutive years south of Rapid City, South Dakota, near Rockerville. This insect is a federally and state listed noxious pest that was accidentally imported from Europe, and is subject to quarantine regulations.

In the caterpillar stage, gypsy moths voraciously defoliate their host trees and shrubs, which may include over 300 species. Preferred hosts include oak, aspen, and birch, but they will also feed on pine and spruce. Defoliated hardwoods take on a barren win-

ter appearance, trees become weakened and sometimes die, and the caterpillars can be a nuisance to people. Trees weakened by defoliation become targets for other insects and diseases that can successfully attack and kill stressed trees. One complete defoliation can be fatal to conifers.

The gypsy moth overwinters in velvety egg masses containing up to 1,000 eggs that are attached to trees, stones, logs, and outdoor objects. Eggs hatch in spring and the young larvae are readily dispersed by the wind. The caterpillars feed through late June or early July. They pupate and remain in their dark-brown pupal cases attached to a variety of objects for 10 to 14 days. Male adults fly to the flightless females to mate. Eggs may be laid from July to September.

Unightly defoliation of pine caused by the pine sawflies, *Neodiprion autumnalis* and *N. gillettei*, occasionally becomes widespread, especially in stressed stands. Populations build up rapidly, but abruptly decline after 1 to 3 years due to natural causes. Because larvae consume old foliage, leaving the newest needles, their feeding weakens trees and slows growth, but usually does not kill trees outright. Damage is short-term and primarily aesthetic.

The eggs of the sawflies hatch in late May or early June. The caterpillars feed gregariously on old needles until late July. They then pupate in the ground, being found in small brown cocoons to a depth of several inches in the mineral soil. The wasp-like, adult sawflies emerge in autumn, and the female deposits her eggs in needle tissue with her saw-like ovipositor. Defoliated trees appear red or brownish in late summer, but green up the following spring, although crowns will remain thin for 2 or 3 years.

A couple other pine defoliators occasionally become abundant in localized areas of the Black Hills. The Black Hills pandora moth, *Coloradia doris*, occasionally becomes epidemic in the southern hills on ponderosa pine. The most recent outbreak occurred from 1989 to 1991 in a localized area. The insect requires 2 years to complete its development; therefore, the heaviest feeding damage occurs in alternate years. This gives trees an opportunity to recover between defoliations. Most affected trees are weakened and growth is slowed, but few die unless they are completely stripped of foliage.

A pine tussock moth, *Dasychira grisefacta*, infrequently defoliates large areas of young, sapling or

pole-sized ponderosa pine. About 300 acres were heavily defoliated in the southern hills during 1992. Affected trees take on a reddish or bronzed and ragged appearance. Trees become weakened and branch and tree mortality may occur. Adults appear in late July to August, and females deposit eggs in clusters on needles. Eggs hatch in late summer and larvae feed for a short time before finding overwintering sites beneath bark scales. Larvae resume feeding in spring, first feeding on male flowers, then moving to needles. They pupate in hairy cocoons attached to twigs in mid-summer. A virus disease appears to be important in gradual population decline over several years.

The forest tent caterpillar, *Malacosoma disstria*, and spring and fall cankerworms, *Paleacrita vernata* and *Alsophila pometaria*, frequently become abundant defoliators of hardwoods and shrubs, especially bur oak, in the Black Hills. These species separately or together may completely strip large areas of foliage. Tree and shrub growth is reduced and mortality may occur after several years of heavy defoliation. Caterpillars begin feeding as new foliage emerges in spring, then pupate in late spring or early summer. Adults of the forest tent caterpillar and fall cankerworm emerge in late summer to lay eggs on twigs. Adults of the spring cankerworm emerge in early spring to lay eggs on twigs.

The large aspen tortrix, *Choristoneura conflictana*, sporadically becomes epidemic in aspen stands for 2 to 3 years at a time. Trees may become completely defoliated, but generally recover after suffering growth loss. Large flat masses of pale green eggs are laid on the undersides of leaves in June and July. Following egg hatch, larvae overwinter in silken shelters in bark crevices. In spring, larvae begin by mining buds, sometimes consuming all the leaves before they have a chance to unfold. Larger larvae roll leaves into shelters in which they feed and pupate. Adult moths emerge in mid-summer. Outbreaks generally collapse as a result of starvation.

Grasshoppers and Mormon crickets, too, are destructive to Black Hills vegetation, preferring grasses and other understory plants. They have, of course, periodically eaten back grasses on rangeland, which reduces a grassland's value to livestock and grazing species of wildlife. Additionally, though, grasshoppers can girdle small tree seedlings just above the ground line. Nymphs and adults continue to feed throughout the growing season. Mormon crickets

were especially abundant in certain locales in Wyoming during 1990 to 1992. Grasshopper and Mormon cricket populations tend to increase in dry years.

One other insect species that has caused notable vegetation damage in the past includes the pine needle scale, *Chionaspis pinifoliae*. It is especially common along dusty roads. Infested needles become discolored and may fall prematurely. Some trees become so heavily infested with pine needle scale that they appear to be covered with a heavy frost. Although damage is primarily aesthetic, severely infested trees are less vigorous and occasionally may be killed.

Eggs overwinter beneath the protective covering of the female scale. Eggs hatch in early spring and the crawlers disperse to feeding sites on needles. The crawler molts to an immobile nymph stage that feeds on the sap and secretes a scale covering. Scales mature in July and appear as tiny, white, oblong, waxy spots on the needles. Eggs are laid for a second generation that matures by fall.

With the exception of the gypsy moth, these common insect pests have historically appeared in the Black Hills, at least since the early 1900's. In many cases, actions of insect pests may be considered a natural phenomenon; however, the frequency and intensity of population outbreaks are affected by both natural and human-caused perturbations to the ecosystem. Several insect pests have become more visible in recent years in response to moisture stress in trees caused by drought. Suppression of wildfire in this century has resulted in more dense stands of timber that are more susceptible to attack by mountain pine beetle, especially in the absence of thinning and harvesting activities to maintain healthier densities of trees. For the mountain pine beetle, especially, preventative management of timber stands can reduce the degree of adverse impact caused by insect outbreaks, just as fuels reduction techniques reduce the likelihood of widespread, catastrophic fires. Additionally, widespread tree mortality caused by insects may increase fuel loading and affect the intensity of fires which may occur in the future. Where timber production and protection of property are primary objectives, such a result is clearly undesirable. However, where intensive management is not a primary focus, insects can act to correct imbalances in the ecosystem, functioning as a thinning agent for over-dense stands and culling weakened trees. Widespread tree mortality caused by insects, especially

when followed by fire, initially results in many fallen trees and restricted access to large game species and recreationists, but eventually opens up large areas of forest, recycles nutrients, and initiates a new cycle of vegetative growth. This may increase or decrease habitat diversity depending upon the extent and distribution of affected trees. However, diverse habitats support a greater diversity of insect and other invertebrate species, especially including beneficial natural enemies, and contributes to greater ecosystem stability and reduces the impact of pest epidemics. Large areas of contiguous forest in the same age class, especially when comprised predominantly of one tree species, have greater risk of being attacked by insect pests and sustain greater spread and total damage during epidemics. A greater mixture of age classes and vegetation species contributes to a healthier forest in terms of the insect and other invertebrate biota. Certainly, the native insect pests will continue to be with us in the future. The degree to which we attempt to manage and suppress insect pests will depend largely on how we want the forest to look in the future.

Endangered and Sensitive Insects and Snails

In recent years, several species of insects and snails have been identified as being sensitive or endangered. Not all are known to occur in the Black Hills, but reported sightings are near enough for consideration.

***Necrophorus americanus* (American burying beetle) (Coleoptera)**

This species was listed on the federal register as endangered in July 1989. Currently, populations are known to exist on Block Island off the Atlantic coast in Rhode Island, in eastern Oklahoma, and near Valentine, Nebraska. Its historical range included 32 states, 2 Canadian Provinces and the District of Columbia. All specimens from South Dakota were collected in the 1940s, are associated with rivers, and are from the counties of Haakon, Union, and Brookings. There are no known records from Wyoming. The beetle breeds on vertebrate carrion, birds, mice, and snakes, and other small animals, in the 100-200 gram range. A recent survey on the Nemo Ranger District was negative.

The following species are of concern to the US Fish and Wildlife Service, but are not currently listed as threatened or endangered under the Endangered Species Act. Measures to prevent further decline, particularly habitat conservation, may reduce the likelihood that they will be listed.

***Speyeria idalia* (regal fritillary) (Lepidoptera)**

This is a Category 2, status "declining" species that is widespread in South Dakota. It was once widespread across North America. Collection records exist from Ft. Meade (Meade Co.) and Custer State Park (Custer Co.), and from the counties of Pennington, Lawrence, Fall River, Shannon and others in South Dakota, and from Platte Co. in southeastern Wyoming. No recoveries have been made in the Black Hills National Forest. Larvae feed on violets, a grassland associate that requires moisture.

***Phyciodes batesi* (tawny crescent) (Lepidoptera)**

This is a Category 2, status "declining" species known to occur in the Black Hills National Forest. Historical evidence indicates this species is associated with the eastern deciduous forest type. Collections have been made recently at 19 sites in Custer, Lawrence, and Pennington Counties in South Dakota. A collection record has been reported from Crook Co., Wyoming (Stanford, 1985). It is not listed in "An Annotated Checklist of the Rhopalocera (Butterflies) of Wyoming" (Ferris, 1971), but probably occurs in some of the Wyoming portion of the Black Hills National Forest. It is restricted in South Dakota to moist forest borders, especially riparian situations. Larvae feed on *Aster simplex* in the Dakotas, which occurs in moist grassland areas.

***Chlorochroa choabelfagi* (elongate ovate stink bug) (Hemiptera)**

This is a Category 2, status "declining" species about which little is known. There are two collection records from South Dakota, one from a wet site in a short grass prairie and one from Brookings County. Most, but not all, species of stink bugs are predators on insects.

***Discus shemeki cockerelli* (Cockerell's striate disc snail)**

This is a Category 2 species known to occur at a site in Spearfish Canyon that is a mixed

deciduous-coniferous forest and floodplain type of habitat.

Orehelix strigosa cooperi (Cooper's Rocky Mountain Snail)

This is a Category 2 species, status unknown, that seems to prefer bases of north-facing slopes and floodplains with limestone substrate and good vegetational cover, especially of deciduous trees. This habitat is found primarily in the main canyon of Spearfish Creek in the Black Hills.

Vertigo hubrichti (Hubricht's Vertigo Snail)

This is a Category 2 species, status unknown, that is thought to inhabit cooler, well-forested, damp sites, particularly algific patches of decaying, deciduous tree leaves near open vents in otherwise mossy areas.

Exotic Insects Introduced to the Black Hills Area

A number of insect species have been or are suspected to have been introduced to the Black Hills area. Most pest species likely were inadvertently introduced during settlement of the area, as trees and agricultural plants were brought in. More recently, biological control agents, especially pests of weeds, have been intentionally introduced.

Exotic Species Known to be Established

Apis mellifera (honeybee) (Order: Hymenoptera)

On balance, it is considered a beneficial insect due to pollination activities in crops and orchards. Allergic reaction to insect stings causes more deaths per year in the US than all other venomous creatures combined. The honeybee may displace native bee species. It was likely established early during settlement by Europeans.

Cryptorhynchus lapathi (poplar-and-willow borer) (Coleoptera)

This is a weevil (Family Curculionidae) of European origin that attacks willow, poplar, and rarely alder and birch. It was first reported from the Black Hills in 1953, although first reported in the US about 1882. While it can kill individual willow trees and does exert some influence, Froiland (1962) stated that the borer did not

appear to be a major cause of willow mortality. Damage varies by site and species of willow.

Lepidosaphes ulmi (oystershell scale) (Homoptera)

Presumably of European origin, this common, sessile insect has a wide host range including many trees and shrubs, excluding conifers. It frequently causes branch dieback, often kills ornamental plantings, and is reported to have destroyed entire forest stands of ash in Ohio.

Otiorhynchus ovatus (strawberry root weevil) (Coleoptera)

This weevil is very widely distributed in North America, where it was introduced early in the 19th century. Larval tree hosts include arborvitae, hemlock, pines, and spruces. High weevil populations have caused losses in nurseries and ornamental plantings. Adults feed on the foliage of various broad-leaved plants.

Xanthogaleruca luteola (elm leaf beetle) (Coleoptera)

Adults and larvae defoliate all species of elms. It is a serious pest of ornamentals, but is rarely of concern in the forest.

Exotic Species Likely to be Established

Compsilura concinnata (Diptera)

This is a European beneficial insect parasite imported against gypsy moth as a biological control agent. It attacks many other Lepidoptera species.

Dichomeris marginella (juniper webworm) (Lepidoptera)

Larvae mine, feed externally on, and web together needles of a variety of *Juniperus* species. It may seriously defoliate ornamental or permanent plantings and is a pest in nurseries. The species is of European origin.

Fenusa pusilla (birch leafminer) (Hymenoptera)

Larvae of this European sawfly feed on the tissues between leaf surfaces. Frequent outbreaks in the northeastern US result in widespread browning of birch foliage, weakens trees, and kills a few of them.

Otiorhynchus sulcatus (black vine weevil) (Coleoptera)

Plant hosts number over 100 species, including spruce and grape. Adults eat foliage, buds and shoots, but the greatest damage is caused by larvae feeding on roots in nursery and container plantings, often killing plants.

Scolytus multistriatus (smaller european elm bark beetle) (Coleoptera)

This species is the principle vector in North America of Dutch elm disease. Beetles reproduce in elms and *Zelkova serrata*, usually selecting weakened, diseased or recently dead trees. Nuptial feeding by adults infects healthy trees.

Species and Circumstances of Concern

Lymantria dispar (gypsy moth) (Lepidoptera)

There is a possibility that a gypsy moth population has become established near Rockerville, South Dakota in the Black Hills; however, this has not yet been confirmed. Capture of male moths in that area in 1991, 1992 and 1993 has prompted continued large-scale delimitation trapping efforts in 1994. Eradication attempts against isolated, established gypsy moth populations in all areas not officially declared to be generally infested is legally required in the United States. The high number of visitors from infested states and provinces will continue to result in introductions to the Black Hills. This exotic, federally quarantined insect is a major forest pest in eastern North

America. With a broad host range, principally of hardwoods, and an eruptive population behavior, it is capable of widespread, sustained defoliation that can lead to tree mortality, shifts in tree species composition, possible competitive displacement of other foliage feeding organisms, and great nuisance to people.

Exotic Agricultural Pests and Releases of Their Exotic Natural Enemies

It is possible that exotic insect pests of agricultural crops might inhabit areas of the Black Hills National Forest, provided the appropriate host plants are available. It is not known if such a situation exists. In addition, there have been aggressive biological control programs against at least two agricultural pests. These two target pests are *Hypera postica* (alfalfa weevil) (Coleoptera) and *Diuraphis noxia* (Russian wheat aphid) (Homoptera). Releases of many insect natural enemy species recently have occurred in eastern Pennington County and southern Fall River County against *D. noxia*. Information regarding releases against *H. postica* was not readily available.

Limits of Information

The insect fauna of the Black Hills has never been systematically surveyed. It is possible that other exotic species are established that have not been reported here. Records of biological control agents released in the area are scattered and sketchy.

BLACK HILLS NATIONAL FOREST

Exotic Species Released As Biological Control Agents Against Rangeland Weeds:

ORGANISM	TARGET PEST	STATUS
<i>Agapeta zoegana</i> (Lepidoptera)	Spotted Knapweed	unknown
<i>Apthona cyparissiae</i> (Coleoptera)	Leafy Spurge	recovered/maybe estab.
<i>Apthona flava</i> (Coleoptera)	Leafy Spurge	unknown
<i>Apthona nigriscutis</i> (Coleoptera)	Leafy Spurge	recovered/maybe estab.
<i>Chrysolina quadrigemina</i> (Coleoptera)	Klamath weed	established
<i>Ceutorhynchus litura</i> (Coleoptera)	Canada Thistle	recovered/maybe estab.
<i>Hyles euphorbia</i> (Lepidoptera)	Leafy Spurge	not established
<i>Rhinocyllus conicus</i> (Coleoptera)	Musk Thistle	established
<i>Urophora</i> spp. (Diptera)	Spotted Knapweed	established
<i>Urophera affinis</i> (Diptera)	Spotted Knapweed	may be established
<i>Urophera cardui</i> (Diptera)	Canada Thistle	recovered/maybe estab.
<i>Urophera quadrifasciata</i> (Diptera)	Spotted Knapweed	may be established

Black Hills National Forest

Diseases--Historical Perspective

Armillaria Root Disease (*Armillaria ostoyae*)

Pre-Custer (Pleistocene to 1899): Armillaria root disease, a native forest pathogen, has impacted forest dynamics probably for as long as the ponderosa pine forest has existed on the Hills. The pathogen spreads slowly through root grafts, root contacts, and through short distances in the soil. On a landscape level, the presence of the disease creates a patchwork of openings which oscillate in size with time, fire, and regeneration events. Hardwoods may carry this root disease but appear to be tolerant of infection. Thus, nearby hardwoods may have increased their populations within disease areas. Shrubs and herbaceous species may have been more abundant in disease centers as well, due to decreased competition from pines for light, water, and nutrients.

Post-Custer (1900 to 1993): Once pines started to be harvested in the Hills, Armillaria root disease may have increased largely due to the widespread creation of stumps, an unavoidable by-product of management. Where the fungus was present, it would have colonized stumps because host defenses would have been eliminated as a result of the trees being cut. The fungus could survive for long periods of time in those stumps, depending upon stump size. The fungus may then have increased in virulence and readily spread to roots of adjacent trees or advancing regeneration. The larger the stump, the longer the fungus could continue to use the stump as a food source. In an unmanaged forest, infected trees would often fall with much of their infected root system intact, reducing the inoculum levels relative to what would be found in a managed situation, where more infected root systems remain in the soil. Other stresses to trees that normally occur during logging operations, such as soil compaction and wounding to residual trees, also enhance disease spread because the fungus is better able to overcome tree defenses when its host is stressed. We do know that the root disease is common throughout most districts on the Black Hills NF based on recent roadside surveys documenting its distribution (Lundquist 1991). We also know that some areas in the Limestone Plateau have

more than 10% of their land area occupied in root disease pockets (Holah, personal observation).

For the reasons stated above, it is quite probable that the high-grading and clearcutting that commenced after the Custer expedition increased the spread of Armillaria root disease on sites where it was present. However, it is also likely that the conventional logging practices of the present aggravate the disease even more. Previous studies on other forests have shown that disease spread is more dependent on the frequency of cutting rather than the intensity of the operation. Recent disease surveys in the Spearfish Ranger District show that stands that have been entered more recently than other stands have about the same number of root disease centers but over twice the acreage is occupied by the root disease (10% vs. 5%).

The suppression of fire in the Hills, beginning in the 1930's, may have impacted the spread of the root disease as well. Some studies have shown that fire, especially high intensity fires, can directly destroy inoculum present in stumps, as well as reduce rhizomorphs (black 'shoestrings' of the fungus that are able to grow freely in soil for short distances) in the soil. Though there is no data, it has been hypothesized that the fire frequency and intensity determines the susceptibility of a stand to disease by its influence on tree vigor and stand structure. Heating of the fungus generally decreases its viability and makes it more susceptible to parasitism by other fungi. The denser stands of pine that result from fire suppression increase overall stress on the trees because of the greater competitive interactions for resources, potentially increasing a tree's chances of succumbing to Armillaria infection.

Endemic mountain pine beetle populations and root disease often occur together. Because of the increased amount of host material available for the mountain pine beetles, the beetle population, overall, may be higher than what was found before Custer's day. One can speculate that increased beetle populations would exacerbate the root disease as the beetles stress trees and thus enhance disease spread.

Red Ray Rot (*Dichomitus squalens* (or *Polyporus anceps*))

Pre-Custer (Pleistocene to 1899): This native heart-rotting pathogen has also been present on the Hills for thousands of years. The large, older ponderosa

pinus that predominated in parts of the Hills before settlement would harbor large amounts of interior decay due to this pathogen. Volume losses of 20% for stands would not be uncommon. Large trees with excessive decay would be more prone to wind breakage during storms and advanced decay would probably provide good habitat for cavity-nesting birds. Because advanced decay can lead to trunk breakage of older trees, the presence of red ray rot would provide an added structural heterogeneity on the landscape scale in the form of small gaps occurring randomly throughout old growth stands.

Post-Custer (1900 to 1993): The high-grading and clearcutting common early in this century would have been significantly impacted by the presence of this disease because the trees harvested were older than 100 years. Once much of the original forest was harvested and rotations shortened, the heartrot was not as much of a concern since advanced decay would not be present in the younger trees. The fungus can often be found fruiting on cull and downed wood, as it also acts as an important secondary sapwood decayer.

Aspen Diseases

Pre-Custer (Pleistocene to 1899): Aspen stands before settlement would have contained less heart rot and girdling canker fungi than are found in stands today. The high frequency of fire that was present in the Hills would have prevented most aspen stands from reaching the old ages that current aspen stands attain. Regeneration after fire would be more vigorous than what would occur today because the younger burned stands would have less disease and more carbohydrate reserves.

Post-Custer (1900 to 1993): As aspen stands age in the absence of fire, the stands have more heartrot, primarily due to *Phellinus tremulae*, and more pathogenic girdling agents. The increased disease and mortality in older stands decrease available carbohydrate reserves in the root system, which generally leads to poorer regeneration. Cutting in aspen stands, especially partial cuts within clones, would greatly increase sunscald incidence, a condition to which aspen is highly susceptible. Sunscald, wounding, and other by-products of thinning operations, increase an aspen's susceptibility to pathogenic agents, especially cankering agents, like hypoxylon and sooty-bark cankers. Other post-settlement activities such as firewood cutting and excessive grazing

by large ungulates increase wounding and thus increase disease incidence.

Hardwood Diseases Associated with Drainages

Pre-Custer (Pleistocene to 1899): Historical evidence, primarily photographs and early botanical expeditions, lead one to believe that populations of willows, ash, cottonwood, elm, and oak were greater than what exists today, and that native populations have declined steadily since settlement in the area. There is little evidence of what sort of diseases commonly afflicted these populations. Even today there is very little information regarding diseases of many hardwoods in the Hills. The diseases that we do find today affecting these hosts probably were also present before settlement. These diseases include primarily cankering agents such as *Cytospora* and *Botrydipodia*, bacterial wetwood common on older trees, leaf rusts, and various heartrotting fungi.

Post-Custer (1900 to 1993): The populations of most of these hardwood species have declined since settlement of the area. Dutch Elm disease, which was first reported for the Hills in 1976 within Fall River County, destroyed most of the native American elm populations that were often found along drainages. A few scattered mature elm remain, as well as young suckers from the previous population; however, it is only a matter of time before the mature remnants are infected by the disease and the young suckers are old enough to eventually become successfully infected. *Cytospora* canker on willow has caused extensive dieback, and some mortality, in the 1980's during drought years. *Cytospora*, and other cankering agents, cause extensive damage when their host is drought stressed. There is speculation that the water table in drainages has lowered since fire suppression. Pines have encroached in these areas, thus decreasing water availability to drainage hardwoods. This decreased availability would lead to increased water stress and an increased susceptibility to potential mortality-causing agents, such as *Cytospora* canker. Wounding agents, such as browsing, by large ungulates, would also increase a hardwood's susceptibility to disease.

Major Plant Diseases in the Black Hills

Innumerable diseases affect many different plant species found in the Black Hills. Several are more notable, however, when they affect the economic via-

bility, aesthetic quality, and structural diversity of the forest tree species in the region.

The two diseases of widest concern in terms of volume loss in the Black Hills are red ray rot and *Armillaria* root disease.

Red ray rot, caused by the fungus *Dichomitus squalens* (*Polyporus anceps*), produces a white-pocket rot in ponderosa pine in the Hills and leads to the destruction of sound wood necessary for commercial production. All types of pine in all age classes are susceptible to red ray rot infection except for seedlings and small saplings. However, it is of particular importance for mature and old-growth pines because the rot is generally much more advanced in older trees, making the volume loss due to the rot significant. Volume losses of 5% or more should be expected for trees 150 years of age or older. In addition to volume loss due to the disease, the presence of the rot in large trees can cause branch and top failures which poses a hazard in recreation areas.

Infection is established in living trees through the branches. According to Alexander (1987), "Nearly all decay develops from airborne spores released by fruiting bodies associated with sap rot of dead material." Spores may continue to develop annually for about 6 years and germinate in small openings in the bark of dead branches when moisture is favorable. After germination, the fungus forms a thick mycelium pad between the wood and the bark, adhering the bark tightly to the wood. The infection spreads toward the bole through both wood and pith of the branch. When the infection reaches the heartwood, the rot spreads up and down the trunk. Thus older pines, which have harbored an infection for a longer period of time, generally have a much greater proportion of heart rot than younger pines.

It is difficult to spot red ray rot in living trees, because few visible signs, if any, are evident. It is difficult, therefore, to predict the amount of volume lost to red ray rot until actual cutting of the tree is done. Generally, stands that develop in dense conditions, have a lower incidence of this disease (Andrews, 1955).

Another economically devastating disease to ponderosa pine in the Black Hills is the root disease fungus *Armillaria*. Surveys have shown that the root disease is common and widespread in the Black Hills; however, information is just beginning to be gathered to determine the impact of the disease to ponderosa

pine volume. The distribution map of *Armillaria* incidence in the Black Hills may be useful as a risk-rating guide for identifying potential problem areas during project planning. This disease similarly affects Black Hills spruce and a number of hardwood species. Disease development is greatest in trees of reduced vigor.

The root disease affects trees of all ages, though the smaller and/or less vigorous the tree, the more quickly it will succumb to the girdling action of the fungus. Disease spread is primarily by root grafts and contacts of infected trees or stumps to healthy trees. The fungus is also able to grow for short distances (up to about 10 inches) in the soil via special structures called "rhizomorphs," or what typically looks like a thin, black shoestring. This is why *Armillaria* is often called the "shoestring root disease."

Diagnosis of tree death due to *Armillaria* involves finding its white, sometimes creamy, latex-like mycelium under the bark on the roots or around the root collar. Because the disease spread is underground and between adjacent trees, areas affected by the disease are characterized by patchy openings containing fallen trees. Symptomatic trees often line the edges of such openings displaying thin crowns, yellowing, and decreased overall growth. In the Black Hills, *Armillaria* centers are often found in conjunction with mountain pine beetle areas.

Western gall rust, caused by *Endocronartium harknessii*, is another disease common to ponderosa pine in the Black Hills, and is especially prevalent in some areas that were unintentionally planted with infected seedlings following large fires. This rust fungus poses a minor economic threat to the pine. The rust affects the form of the pine, producing swellings on branches and hip cankers on trunks, and can affect the growth rate of a pine as it diverts energy from other parts of the tree. Infections on the bole can result in lumber defect or tree breakage. Mortality due to the rust is unusual, and most typically occurs with seedlings and saplings planted off-site. The disease can be an important concern in recreation areas in terms of loss in aesthetic value of pines. Affected branches and stems are more prone to failure in bad weather and thus pose a hazard in heavily-used recreation areas.

Gall rust infects pine of all ages. According to Alexander, "Most infections occur on twigs of the current season. When the rust invades pine bark, cambial

cells of the pine shoot begin to divide rapidly. The result is a woody gall, soft at first, but later as resins and other deposited material solidify, the gall becomes harder and more decay resistant than normal wood." Gall infections on small stems or branches will eventually girdle the host tissue, whereas infections on trunks or larger branches may persist for long periods of time without girdling the host.

Two needle diseases, caused by *Elytroderma deformans* and *Diplodia pinea*, are common on ponderosa pine and are only important in terms of loss of aesthetic value to pines in the Hills. *Elytroderma* needle cast causes brooming and some defoliation on ponderosa pine, but it is not a serious problem. It is most often found on trees in sheltered areas, like on bottoms or in thickets of reproduction. Witches' brooms often develop in crowns of trees after several years of light to moderate infection. These brooms have been the basis of several erroneous reports of dwarf mistletoe in the Black Hills.

Though most common in ornamental or windbreak plantings, *Diplodia* needle blight occurs in low levels in natural ponderosa pine forest. The loss *Diplodia* induces is usually aesthetic, with the browning of new shoot needles and dieback of shoot tips, and is often temporary. Infection occurs after injury to branches, often following a hailstorm.

Dwarf mistletoe, a devastating disease in other parts of the Rocky Mountains, seems absent from the Black Hills. Although this disease has successfully infected Black Hills ponderosa pine in controlled tests, the climate of the Black Hills appears to be a limiting factor.

Spruce broom rust, caused by *Chrysomyxa arctostaphyli*, is a rust fungus which infects Black Hills spruce branches and causes a witch's broom. This disease is also commonly mistaken for a mistletoe, and is not of economic importance in the Hills at this time.

Very little is known about diseases that affect Black Hills spruce, but it does appear to be susceptible to a butt-rotting agent(s) which increases its susceptibility to windthrow. Spruce also is affected by *Armillaria* root disease, though to what extent is not yet known. Both types of disease agents pose a hazard situation in public recreation areas. The presence of conks or mushrooms on the tree or directly at the base of a tree provide clues as to the condition of its interior.

Many of the hardwoods present in the Black Hills, such as aspen, birch, and oak, may experience heart rot decay caused by a variety of pathogenic fungi. Trees with the greatest amount of decay are generally those that are older and have harbored the decay fungi for a longer period of time. Heart rot decay fungi generally do not actively kill trees, but older trees with much decay pose a serious hazard to the public in recreation areas. The most common means of recognizing heart rot is the presence of conks and/or nesting holes on living trees.

Much of the older aspen in the Hills is affected by *Phellinus tremulae*, a pathogenic heart-rotting fungus which can produce a white, stringy rot throughout much of the bole. Though trees are often infected with the fungus when they are young, decay is generally not advanced until the tree is much older because of the long period of time required by fungi to decay sizable volumes of wood. In addition to being a concern in recreation areas, this decay fungus would pose a significant hindrance to any aspen wood industries, though this is not a current concern in the Black Hills. Birch is affected by the heart rot decay fungus *Fomes fomentarius*, though this fungus appears to primarily decay dead trees. Oak is affected by a variety of heart rot fungi. A few of the more common heart rotters are *Phellinus gilvus*, *Phellinus robustus*, and *Phellinus everhartii*. All of the heart-rotting fungi provide valuable habitat for cavity-nesting birds, as is especially the case for aspen.

Melampsora rust is a leaf disease that is commonly seen on aspens, willows, and cottonwoods in the Black Hills, though the incidence and severity of this fungal rust disease is largely dependent on seasonal weather conditions. Generally, the presence of this rust disease involves no more than a loss of aesthetic value to a tree or a landscape. However, trees heavily hit by the rust disease experience premature leaf drop and an accompanying loss of vigor. Repeated severe infections can significantly weaken the tree via a depletion of carbohydrate reserves so that the tree becomes more susceptible to other diseases, which can eventually lead to mortality. Native stands of hardwoods are usually not as heavily affected by this rust fungi as planted stands.

Aspen in the Hills is also affected by a variety of cankering fungi, such as *Diplodia tumefaciens*, *Cytospora* sp., and *Cenangium singulare*. Most cankering agents gain entry into their host via wounds, thus trees heavily afflicted by cankers are often found

in campgrounds and other heavily used areas. A "cankering" agent which has recently been cause for concern in some areas of the Hills is *Cryptosphaeria populina*. This fungal pathogen enters young trees, or trees generally less than 11 inches in diameter, and kills the sapwood. Only after sapwood parasitism has taken place for a few years does an elongate canker develop on the trunk. This disease may be of more importance in future aspen regeneration projects as some young aspen stands in the Hills may have experienced significant mortality primarily from this agent. With the notable exceptions of *Cryptosphaeria* and *Cenangium*, or "sooty bark canker," most cankering diseases do not lead to mortality. However, multiple infections on a single tree can eventually girdle a stem and the structural impairment resulting from a canker leads to an increased probability of windthrow. For this reason, campgrounds, picnic grounds, and other heavily used recreation areas near large, cankered aspens do pose a hazard to the public.

Understandably, tree diseases receive most notice when they have an economic impact on an industry. A decrease in the value of timber, a loss of volume in a stand due to mortality or poor regeneration, and poor growth due to a loss in vigor are effects that disease can have which are easily translated into dollar amounts. In terms of effects on an ecosystem, however, disease effects are less easily definable. Diseases which cause large and small scale gaps, e.g., *Armillaria* root disease and cankering diseases respectively, certainly provide a structural diversity to the forest that would not be present otherwise. The structural complexity added by disease influences biodiversity of the forest as a variety of species may establish in a gap, an opportunity crucial for the survival of some less competitive species. The presence of disease can have positive or negative influences on wildlife as well. For example, habitat for cavity-nesting birds can be increased with the presence of heart-rotted trees, and browse for large mammals is decreased due to poor regeneration of aspen in some diseased areas. In terms of aesthetic value, rust and cankering diseases can have an impact, especially in areas that are "visual corridors." The presence of disease in recreation areas is often overlooked, but tree failures can precipitate serious safety and liability problems. Thus, disease can have a far-reaching effect in the forested ecosystem, and our perception of these effects depends on our focus.

Diseases Introduced to the Black Hills

Dutch Elm Disease (*Ceratocystis ulmi*)

This devastating wilt disease, native to Holland, was introduced to the United States in the 1930's and is responsible for the destruction of elm populations, especially American elm, from coast to coast. The disease was first reported in South Dakota in 1967 in Minnehaha County and in the Black Hills area in 1976 within Fall River County. A few native American elms remain in their hardwood drainage habitat, but only as escapees from the disease, not due to resistance. American elm suckers are still present from remnant mature trees, but before they reach reproductive maturity they are usually hit with this disease.

White pine blister rust (*Cronartium ribicola*)

This rust disease from Asia was introduced to the United States in the early 1900's and destroyed the white pine timber industry. The disease occurs on many 5-needled pines and was found in 1991 on isolated stands of limber pine near Cathedral Spires in the Hills. Incidence of infection is low and the rust may have been present in these stands for decades.

Effects of Management Relative to Insects and Diseases

Management alternatives that change the mix of age classes and densities of forest stands will have effects upon the insect and disease components of Black Hills environments.

The most destructive insect pest in the Black Hills, the mountain pine beetle, prefers larger ponderosa pine trees growing in dense clumps and stands. Sartwell and Stevens (1975) identified stands with basal areas equal to or greater than 150 sq. ft. per acre and average tree diameters equal to or greater than 8 inches to be conducive to MPB outbreaks. Lessard (1982) reported that even-aged stands with about 75% or more of the trees in the 7.1-13.0 inch diameter classes were most susceptible to attack.

Risk-rating systems provide a means for indicating relative levels of damage that are likely should an infestation develop in a particular stand, and are useful for prioritizing harvest activities at the project level. For mountain pine beetle, a risk-rating system for

identifying high, medium, and low risk stands of ponderosa pine in the Black Hills was developed using combinations of stand structure, tree diameter, and basal area (Stevens et al. 1980). More recently, Schmid and Mata (1992) suggested that 120 sq. ft. per acre may be the critical basal area for separating high risk stands of susceptible-sized trees in the Black Hills, rather than 150 sq. ft. per acre. The risk-rating system, modified to incorporate the 120 sq. ft. per acre basal area figure, was used to generate stocking charts showing low, medium, and high risk zones for single-storied and two-storied stands. Little tree mortality results from mountain pine beetle attacks when stands are thinned or partial cut to less than 90 sq. ft. per acre of basal area (McCambridge and Stevens 1982). Stands partial cut to 80 BA (sq. ft. per acre of basal area) would become highly susceptible again in 25-30 years, those cut to 60 BA in about 50 years, and those cut to 100 BA in about 11-15 years (Schmid and Amman 1992).

Management alternatives that increase the amount, extent, or density of mature and overmature ponderosa pine stands will result in increased risk of attack by mountain pine beetle, setting the stage for major epidemics of mountain pine beetle. Alternatives that increase the amount and extent of even-aged stands of ponderosa pine similarly will increase risk of mountain pine beetle attack. Epidemics of mountain pine beetle are capable of destroying large percentages of trees in susceptible stands. Tree mortality of this magnitude, in turn, reduces timber yields, and changes the stand structure, species composition, and successional trends. Such changes can enhance biological diversity by encouraging other plant species, such as paper birch, and promoting a greater mix of age and size classes; however, the result may not advance efficient timber production goals. On the other hand, extensive outbreaks can also reduce biological diversity by regenerating expansive areas to virtually a single age class. Additional effects of increases in mountain pine beetle outbreaks may include increases in fire hazard, stream flow, and herbage production.

In contrast, management alternatives that decrease the amount, extent, or density of mature and overmature ponderosa pine stands or reduce the amount and extent of even-aged stands, will reduce risks of attack by mountain pine beetle. Creating younger stands and a greater mixture of ages within and across stands will reduce the likelihood of extensive outbreaks of mountain pine beetle. Such a forest

would likely sustain less damage when an outbreak does occur.

Enhancing biological diversity of vegetation, in turn, provides greater habitat for parasite and predator species that help regulate populations of a variety of potential insect pest species.

A number of insect pests become abundant in response to tree stress, such as drought or injury. Most management alternatives will have little visible effect on levels of most of these species. However, species such as *Ips* and red turpentine beetles that can build up in logging debris, scarred trees, and stumps, may decline under management alternatives that reduce harvesting levels of pine.

A number of tree diseases are likely to become more prevalent under management alternatives that increase stands of older trees. This is especially true for red ray rot, caused by *Dichomitus squalens*, and already contributes to significant losses of ponderosa pine volume in stands greater than 130 years of age. Butt rot of Black Hills spruce can also be expected to increase as more trees reach mature and overmature age classes. Decay of aspen, birch, and oak also increase with advancing tree age, but make important contributions to biological diversity in the form of habitat for cavity nesters. However, if extensive areas of aspen and birch are allowed to become heavily diseased, regeneration of those areas to the same species may become problematic because of their clonal nature.

The effects of management alternatives on incidence of *Armillaria* root rot is not as readily discernible as for other major pest species. Environmental stresses, both abiotic and biotic, can predispose trees to attack, but predisposition does not seem to be a prerequisite for infection in ponderosa pine. Disease incidence tends to be greater on sites disturbed by logging activity, fire, insects, and other diseases. Partial cutting can intensify root disease due to "thinning shock"; the fungal inoculum in cut stumps will quickly and readily spread to adjacent root systems and regeneration. However, overstocked and stagnated stands also allow greater root disease development. *Armillaria* is commonly found in association with mountain pine beetle infestations, which are attracted to overdense ponderosa pine stands (Lessard et al., 1985). Preliminary results of recent disease surveys indicate that small pockets of mountain pine beetle are in the vicinity of root disease centers over

80% of the time (Holah, personal observation). Root disease generally is not increased by pre-commercial thinning (Wargo and Harrington 1991). Whether root disease intensifies or not following commercial logging activities depends largely on the level of disease present prior to cutting, stand age, and the frequency of cutting in a particular stand (Kile et al. 1991). The greater the occurrence of *Armillaria* infections prior to harvest, the greater the chance of causing increases in disease spread. In both managed and unmanaged stands, *Armillaria* plays a significant role in "gap ecology," creating openings in the forest and contributing to greater biological diversity.

The background information on insects and disease was gathered to assess and address the affected environment. The information was also used in addressing the effects in each alternative in the Proposed Revised Black Hills National Forest Plan. This includes the direct effects, indirect effects, effects by resource, and cumulative effects. Legal obligations

which may be associated with the alternatives were also examined.

Information prepared by Forest Health Management personnel as participants in the interdisciplinary team analysis process was taken into consideration in developing a preferred alternative which will meet the needs of the public, as well as perpetuate ecosystems found in the Black Hills. The end result of the effort will be set forth as management direction in the Final Revised Black Hills Forest Plan, which will guide management activities for the subsequent ten year period.

It is critical that Forest Health Management personnel participate actively as interdisciplinary team members in forest and project planning efforts if the implications of insects and disease are to be understood and utilized in evaluating the risks associated with any management decision which involves vegetation.

SUMMARY OF INSECT AND DISEASE CONDITIONS ROCKY MOUNTAIN REGION

INSECTS

Douglas-fir beetle *Dendroctonus pseudotsugae* Hopkins

Douglas-fir beetle activity on the Clarks Fork Ranger District of the Shoshone National Forest in Wyoming appears to be declining, and many attacks resulted in pitchouts. Mortality along the Colorado Front Range is still occurring in small, widely scattered groups. Most of the mortality is on steep, inaccessible slopes where western spruce budworm has defoliated trees during the past decade.

Gypsy moth *Lymantria dispar*

Surveys were continued statewide on private land in Colorado. Six moths were caught in 1993: three in Lakewood, one in Denver, one in Boulder and one in Colorado Springs. Moths were caught at two sites in Kansas: one in the Kansas City Area, and one in Dodge City. In Nebraska 10 moths were caught in detection traps in Douglas, Sarpy, and Lancaster Counties. One moth was caught in Wyoming on the Wapiti Ranger District of the Shoshone National Forest. In South Dakota, ten moths were caught in delimitation and detection survey traps located in Pennington, Fall River, Lawrence, and Minnehaha Counties.

Mountain pine beetle *Dendroctonus ponderosae*

Tree mortality declined significantly in the central Black Hills of South Dakota, from 1992 to 1993. The epidemic near Bear Mountain appeared to be collapsing, with the majority of new attacks being pitched out. The small infestation discovered in 1992 in lodgepole pine near Lake Granby on the Arapaho National Forest continued in 1993. Mortality of limber

pine continued in Tensleep Canyon on the Bighorn National Forest in Wyoming, while the outbreak in ponderosa pine at Laramie Peak, Wyoming, dramatically decreased in 1993. Several small infestations along the northern front range appeared to be increasing.

Western spruce budworm *Choristoneura occidentalis*

Defoliation of mixed conifer and subalpine forests continued in the Gunnison zone in 1993. Most of the defoliation occurred on the Salida District of the San Isabel NF, on the Creede and Del Norte Districts of the Rio Grande NF, on the Ouray and Paonia Districts of the Gunnison NF, the Rifle District of the White River NF, and on National Park Service lands in Gunnison County, Colorado. Areas along the Front Range on the Pike NF and adjacent intermingled state and private lands experienced moderate defoliation. Defoliation was negligible in 1993, in Wyoming.

STEM AND BRANCH DISEASES

Comandra blister rust *Cronartium comandrae*

Comandra blister rust continues as one of the major diseases on the Bighorn and Medicine Bow National Forests in Wyoming, as well as the southern portion of the Shoshone National Forest. A minor infestation of blister rust was found in a young lodgepole pine plantation near Horseshoe Campground on the Arapaho National Forest in Colorado. The disease is present in western South Dakota but causes no significant damage.

Dwarf mistletoe *Arceuthobium americanum*

Dwarf mistletoes cause the greatest disease losses in Region 2. In Colorado, 50% of the lodgepole pine type is infected. In Wyoming, it is widespread in some areas of the Bighorn National Forest, though not yet a management concern.

Dwarf mistletoe *Arceuthobium douglasii*

Moderate to high levels have been detected in Douglas-fir stands near North Cochetopa Pass in south central Colorado.

Dwarf mistletoe *Arceuthobium vaginatum*

The disease continues to be a factor affecting management of ponderosa pine on the San Isabel, San Juan, and Uncompahgre National Forests, and on the Southern Ute Reservation in southern Colorado.

CANKER DISEASES

Cytospora canker *Cytospora* spp.

Cytospora canker is common on aspen throughout Colorado, where it is a management concern in regeneration and recreation areas. Stands affected by the disease were noted on the Gunnison, Uncompahgre, San Isabel, San Juan, and Rio Grande National Forests and at the Crested Butte and Aspen Mountain ski areas. It is widespread on aspen in the Black Hills, usually on trees weakened by other diseases and/or insects. This was probably the worst year ever for Cytospora canker in western Kansas.

ROOT DISEASES

Annosus root disease *Heterobasidion annosum*

Annosus root disease was reported as a factor affecting management of mixed conifer stands on the Southern Ute Reservation and white fir in the Amphitheater Campground on the Uncompahgre National Forest.

Armillaria root disease *Armillaria* spp.

Armillaria root disease is the most common root disease in Colorado. The disease is affecting management of mixed conifer stands on the Southern Ute Reservation and is present in the spruce/fir stands at the Truby Complex Timber Sale Areas on the San Juan

National Forest, and near Priest Lake on the Uncompahgre National Forest. The disease is also a major problem in the spruce/fir leaf strips at the Aspen Mountain ski area and is killing scattered firs in similar leaf strips at the Crested Butte Mountain Resort ski area. In South Dakota, this root disease is widespread in the central and northern portions of the Black Hills National Forest and continues to cause mortality of white spruce and ponderosa pine.

FOLIAGE DISEASES

Moderate to low occurrence of several foliage diseases of aspen caused aesthetic concern but little permanent damage to host trees in Colorado. Dothistroma needle blight on Austrian and ponderosa pine was moderate to severe in eastern Kansas. Brown spot needle blight on scotch pine was also moderate to severe in eastern Kansas. Diplodia blight of ponderosa pine in the Black Hills of South Dakota was similar to 1992; however, over 17,000 acres were heavily affected in western Nebraska. *Lophodermella* needle cast was extensive on lodgepole pine in the southern Bighorn Mountains of Wyoming, and was especially severe on seedlings and saplings.

VASCULAR WILTS AND DECLINES

Dutch elm disease *Ceratocytis ulmi*

The incidence of dutch elm disease was up slightly in Colorado in 1993, but this was attributed to the freeze damage of October 1991. There was a large increase in trunk attacks by bark beetles due to the '91 freeze increasing the decline of trees in the Colorado Springs area. It is still a serious problem in many urban areas in Kansas.

ABIOTIC

Chemical damage

Damage from accidental herbicide application to windbreaks and other tree plantings contin-

ues to be a serious problem throughout the Region.

Winter drying injury

Damage was also noted for all conifer species along the north face of Casper Mountain in central Wyoming.

OTHER

Sprout dieback

Examples of regeneration failure and dieback may be found on the Grand Mesa, Uncompahgre, Gunnison, San Juan and Routt National Forests. Snow damage, dry sites, wet sites, herbivore pressure, competing understory, soil evolution, and disease may be involved.

ROCKY MOUNTAIN REGION INSECTS

Prepared by William H. Blunt

INSECT	HOST	LOCATION	REMARKS
A willow sawfly <i>Nematus</i> sp.	Willow	Wyoming	No significant activity reported in 1993.
Ash plant bug <i>Tropidosteptes amoenus</i>	Green ash	South Dakota	No significant activity reported in 1993.
Aspen leaf beetle <i>Chrysomela crotchii</i>	Aspen	South Dakota	Defoliation not evident in 1993.
Birch skeletonizer <i>Bucculatrix canadensisella</i>	Birch	South Dakota	Defoliation not evident in 1993.
Blackheaded ash sawfly <i>Tethida cordigera</i>	Green ash	South Dakota	No significant activity reported in 1993.
Black Hills pandora moth <i>Coloradia doris</i>	Ponderosa pine	South Dakota	Populations were not apparent in 1993.
Bronze birch borer <i>Agrilus anxius</i>	Paper birch	South Dakota	Recurrent problem in urban areas.
Brownheaded ash sawfly <i>Tomostethusm ulticinctus</i>	Green ash	Colorado	Appears to be increasing its range within Colorado and is causing significant defoliation of ornamentals in south central Colorado. Now found as far north as Denver.
Bull pine sawflies <i>Zadiprion townsendi</i>	Ponderosa pine	Colorado	Defoliated individual trees along the Front Range in Colorado from north of Colorado Springs to Fort Collins.
Cankerworms <i>Alsophila pometaria</i> <i>Paleacrita vernata</i>	Bur oak, Green ash, Elm, Honeylocust, Hackberry	Kansas, South Dakota, Wyoming	Damage was quite low again in 1993.
Common falsepsit scale <i>Lecanodiaspis prosopidis</i>	Green ash, Hackberry, Red Mulberry	Colorado	No significant activity was observed in 1993.
Cottonwood borer <i>Plectrodera scalator</i>	Cottonwood	South Dakota	No significant activity reported in 1993.

Rocky Mountain Region-Status of Insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

INSECT	HOST	LOCATION	REMARKS
Cottonwood leaf beetle <i>Chrysomela scripta</i>	Poplars	Colorado	Common in 1993 on eastern plains.
Dioryctria moths <i>Dioryctria sp.</i>	Pinyon pine, Austrian pine, Ponderosa pine, Scotch pine	Colorado, South Dakota	Scattered outbreaks of this shoot-infesting insect continue to plague pinyon pine throughout southwestern Colorado. These scattered outbreaks are expected to continue into 1994. Localized populations remain in portions of South Dakota and Nebraska.
Douglas-fir beetle <i>Dendroctonus</i> <i>pseudotsugae</i>	Douglas-fir	Colorado, Wyoming	On the Clarks Fork Ranger District of the Shoshone NF in Wyoming, outbreak populations appeared to be declining and many attacks resulted in pitchouts. About 4,000 Douglas-fir trees died in 1993 between Sunlight Basin and Crandell Ranger Station. Mortality along the Colorado Front Range continued to occur in small, widely scattered groups. Most mortality was on steep inaccessible slopes where western spruce budworm had defoliated trees over the past decade. In the Gunnison Zone, populations generally remained static at a low level.
Douglas-fir Tussock moth <i>Orgyia pseudotsugata</i>	Douglas-fir	Colorado	Heavy defoliation was discovered on 250 acres at West Creek, Pike NF. Expansion is expected in 1994.
Elm calligrapha <i>Calligrapha scalaris</i>	Siberian elm	South Dakota	No significant activity reported in 1993.
Elm leaf beetle <i>Pyrrhalta luteola</i>	American elm, Siberian elm	Kansas, Nebraska, South Dakota	Damage was light to moderate in Nebraska, and central Kansas. In other areas of Kansas damage was less than normal.
European pine sawfly <i>Xanthoqaleruca sertifer</i>	Scotch pine	Kansas	Reports of damage were about the same as in 1993 in most of the eastern part of the state, with some areas reporting decreasing populations.
Fall webworm <i>Hyphantria cunea</i>	Cottonwood	Colorado, Kansas, Wyoming	Heavy defoliation noted in some Wyoming sites. Light to moderate damage was reported in eastern Kansas.

Rocky Mountain Region-Status of Insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

INSECT	HOST	LOCATION	REMARKS
Flea beetle <i>Altica</i> sp.	Cottonwood	Colorado	No significant activity reported in 1993.
Grape mealybug <i>Pseudococcus maritimus</i>	Catalpa, Honeylocust	Colorado	Newly discovered in the Fort Morgan, Brush area.
Greenstriped mapleworm <i>Dryocampa rubicunda</i>	Silver maple	Kansas	Moderate to light defoliation was reported in the eastern part of the state.
Gypsy moth <i>Lymantria dispar</i>	Hardwoods	Colorado, Nebraska, South Dakota, Wyoming	In South Dakota, ten moths were caught in delimitation and survey traps located in Pennington, Fall River, Lawrence, and Minnehaha Counties. No established populations have been confirmed yet. In Nebraska, ten moths were caught in detection traps in Douglas, Sarpy, and Lancaster Counties. In Wyoming, one moth was caught on the Wapiti Ranger District of the Shoshone NF. In Colorado, six moths were caught at four sites in 1993-one in Boulder, one in Colorado Springs, one in Denver, and three in Lakewood. Gypsy moths were caught in traps at two sites in Kansas-one in the Kansas City Area, and one in Dodge City.
Hackberry caterpillar <i>Asterocampa celtis</i>	Hackberry	Kansas	In general, defoliation was quite low. However, several areas of severe defoliation were observed in the northeast part of the state.
Hackberry galls <i>Pachypsylla</i> <i>celtidismamma</i> <i>P. celtidisversicula</i>	Hackberry	South Dakota	Recurrent problem in urban areas.
Honeysuckle aphid <i>Hyadaphis tataricae</i>	Honeysuckle	Kansas Nebraska	This is a relatively new pest in Kansas but is becoming a very serious pest throughout the state. Other shrubs are being selected for windbreaks because the aphid is difficult to control. Widespread in Nebraska.

INSECT	HOST	LOCATION	REMARKS
Juniper sawfly <i>Monoctenus fulvus</i>	Rocky Mountain juniper, Eastern redcedar	Kansas	No reports were received again this year.
Lesser European Elm Bark Beetle <i>Scolytus multistriatus</i>	Elm	Colorado	Found along the Front Range and eastern plains. Very large build-up evident in late summer 1993 along Front Range.
Lilac borer <i>Podosesia syringae</i>	Green ash, Lilac	Colorado, Kansas, Nebraska, South Dakota	Populations remain high to very high in some localized areas in South Dakota. Continues to be a significant pest of green ash ornamentals in Colorado.
Mountain pine beetle <i>Dendroctonus ponderosae</i>	Limber pine, Lodgepole pine, Ponderosa pine	Colorado, South Dakota, Wyoming	Tree mortality declined significantly in the central Black Hills of South Dakota, from 1992 to 1993, nearly an 83% reduction. The epidemic near Bear Mountain appeared to be collapsing, with the majority of new attacks being pitched out. About 6,000 ponderosa pines were killed by bark beetles in South Dakota and Wyoming. On the Bighorn NF in Wyoming, mortality of limber pine continued in Tensleep Canyon. The outbreak in ponderosa pine at Laramie Peak, WY, dramatically decreased in 1993. [However, the gross area affected was about 180,600 acres instead of the 11,000 acres mistakenly reported in 1990 and 1991.] A small infestation that was discovered in 1992 in lodgepole pine near Lake Granby on the Arapaho NF continued in 1993. Several small infestations along the northern front range appeared to be increasing. No outbreaks of this pest occurred in the Gunnison Zone in 1993.
Nantucket pine tip moth <i>Rhyacionia frustrana</i>	Austrian pine, Scotch pine, Ponderosa pine, Virginia pine	Kansas	Damage was quite variable again this year. Very severe damage was reported in south central part of the state. Populations were normal in the rest of the state.

Rocky Mountain Region-Status of Insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

INSECT	HOST	LOCATION	REMARKS
Pine engraver beetle <i>Ips pini</i>	Ponderosa pine, Lodgepole pine	Colorado, South Dakota, Wyoming	Small pockets of top killing and tree mortality continued to be abundant on ponderosa pine but was less abundant in most areas than in preceding years. Pheromone traps were placed in stands being thinned in the southern Black Hills where <i>Ips</i> populations were unusually high. They continue to kill ornamental pine and spruce along the Front Range, especially in the Denver area.
Pine sawfly <i>Neodiprion autumnalis</i>	Ponderosa pine	Nebraska, South Dakota, Wyoming	Outbreaks of the past few years have largely subsided, such that defoliation was generally unnoticeable in 1993. However, larvae could still be readily found at some locations. Defoliation occurred in pine stands along the northern Front Range west of Fort Collins. In some cases, some trees lost 80% of old needles. No mortality is expected.
<i>Neodiprion fulviceps</i>		Colorado	Defoliation is occurring in pines planted in eastern Colorado, especially Pawnee NG.
Pine shoot beetle <i>Tomicus piniperda</i>	Scots pine, White pine	Kansas	Beetle has not been reported in Kansas. A federal and state quarantine has been issued to prevent the spread of the insect into Kansas.
Southwestern pine tip Moth <i>Ryacionia neomexicana</i>	Ponderosa pine	Colorado	Found on ornamentals and windbreaks in eastern Colorado.
Pine tussock moth <i>Dasychira grisefacta</i>	Ponderosa pine	Nebraska, South Dakota, Wyoming	Heavy defoliation occurred on about 2,000 acres in western Nebraska and about 5,000 acres in central Wyoming. Approximately 40% of the trees defoliated on 300 acres in the southern Black Hills of South Dakota in 1992, died in 1993.

INSECT	HOST	LOCATION	REMARKS
Pinyon pitch-nodule moth <i>Retinia arizonensis</i>	Pinyon pine	Colorado	Significant pest of pinyon transplants brought from southern Colorado to Front Range sites.
Red turpentine beetle <i>Dendroctonus valens</i>	Jack pine, Ponderosa pine	Nebraska, South Dakota, Wyoming	Beetle attacks were common on stressed trees throughout the Black Hills of South Dakota and Wyoming. In Nebraska, beetles were commonly associated with Leptographium root disease infecting jack pine.
Tent caterpillars <i>Malacosoma americanum</i> <i>M. californicum</i> <i>M. disstria</i>	Chokecherry, Hardwoods, American plum	South Dakota, Wyoming	Populations were very high, primarily in western South Dakota and Wyoming.
Twig beetles <i>Pityophthorus</i> sp.	Pinyon pine	Colorado	Twig beetles in association with dioryctria moths are causing mortality and branch dieback in Southern Colorado.
Ugly nest caterpillar <i>Archips cerasivorana</i>	Chokecherry	South Dakota	No significant activity reported in 1993.
Walnut caterpillar <i>Datana integerrima</i>	Pecan, Black walnut, Bur oak, Hickory	Kansas	No significant activity reported in 1993.
Walnut trunk-webbing Caterpillar <i>Gretchena concitatricana</i>	Walnut	Kansas, Nebraska	Caterpillars defoliated groups of trees in native stands of walnut in the eastern part of the state. The insect covers the trunk of the tree with thick webbing. The webbing is found mostly on the main trunk but can go out on the branches for a short distance. The size of the tree did not seem to make any difference. Groups of trees in the stand were defoliated instead of individual scattered trees.
Walnut silk moth <i>Gretchena</i> sp.	Walnut	Kansas	Insect defoliates groups of trees in native stands of walnut in the eastern part of the state, near Manhattan.

INSECT	HOST	LOCATION	REMARKS
Web-spinning sawflies <i>Acantholyda</i> sp., <i>Cephalcia</i> sp.	Ponderosa pine, Engelmann spruce	Colorado	Found in significant numbers in ornamental spruce planted in the Black Forest Area of Colorado Springs.
Western pine beetle <i>Dendroctonus</i> <i>brevicomis</i>	Ponderosa pine	Colorado	No significant activity reported in 1993.
Western pine tip moth <i>Rhyacionia</i> <i>bushnelli</i>	Ponderosa pine	South Dakota	Damage continued to be evident in regeneration in the central and southern Black Hills of South Dakota.
Western spruce budworm <i>Choristoneura</i> <i>occidentalis</i>	Douglas-fir, Engelmann spruce, White fir	Colorado, Wyoming	Defoliation of mixed conifer and subalpine fir continued in the Gunnison Zone in 1993. Most of the defoliation occurred on the Salida District of the San Isabel NF, on the Creede and Del Norte Districts of the Rio Grande NF, on the Ouray and Paonia Districts of the Gunnison NF, the Rifle District of the White River NF, and on National Park Service lands in Gunnison County. The activity in these areas is expected to continue into 1994. Areas near South Park on the Pike NF and adjacent intermingled state and private lands experienced moderate defoliation. Defoliation was negligible in 1993 in Wyoming.
White pine weevil <i>Pissodes strobi</i>	Colorado blue spruce	Colorado	White pine weevil damage to spruce leaders continued at a static level in south and central Colorado.
Yellow-necked caterpillar <i>Datana ministra</i>	Oaks, Basswood, Fragrant sumac, Maple, Elm	Kansas	Damage was about normal and populations were not large enough to cause complete defoliation.
Ponderosa twig moth <i>Dioryctria ponderosae</i>	Ponderosa pine	Kansas	An ongoing eradication project is being conducted by the State Board of Agriculture in three counties in northwest Kansas.

ROCKY MOUNTAIN REGION DISEASES

Prepared by William H. Blunt

DISEASE	HOST	LOCATION	REMARKS
STEM AND BRANCH DISEASES			
Ash heartrot <i>Perennipora fraxinophilus</i>	Green ash	South Dakota	No significant activity reported in 1992.
Aspen trunk rot <i>Phellinus tremulae</i>	Aspen	Colorado, South Dakota	Aspen trunk rot is common throughout the aspen cover type in Colorado. In recreation areas, trees with this disease are removed to reduce hazard potential. Heartwood decay due to this rot is widespread throughout aspen stands in the Black Hills NF.
Black knot <i>Apiosporina morbosum</i>	Chokecherry	Colorado, South Dakota	Chokecherry in riparian zones throughout Colorado and western South Dakota is commonly affected by this disease.
Comandra blister rust <i>Cronartium comandrae</i>	Lodgepole pine Ponderosa pine	Colorado, South Dakota, Wyoming	Continues as one of the major diseases of lodgepole pine on the Bighorn and Medicine Bow National Forests, WY. It is a particular management concern along the eastern edge of the Medicine Bow NF adjacent to sagebrush habitat containing the alternate host, <i>Comandra</i> spp. Damage was scattered in older lodgepole stands on the Shoshone National Forest. A minor infestation of blister rust was found in a young lodgepole pine plantation near Horseshoe campground on the Arapaho NF. The disease is present in northern Colorado on lodgepole pine and ponderosa pine in western South Dakota but causes no significant damage.

DISEASE	HOST	LOCATION	REMARKS
DWARF MISTLETOES			
<i>Arceuthobium americanum</i>	Lodgepole pine	Colorado, Wyoming	Dwarf mistletoes cause the greatest disease losses in Region 2. Losses equal at least 10 million cu. ft. annually. In Colorado, 50% of the lodgepole pine type is infected. Forest Health Management funded presuppression surveys on 30,398 acres on five National Forests and silvicultural control on 1,470 acres on five National Forests. Moderate levels of the disease were detected at the Crested Butte Mountain Resort ski area. Vegetation management projects were reviewed in campgrounds on the Gunnison, Uncompahgre, White River and San Isabel NF's. It is widespread in some areas of the Bighorn and Shoshone NF's.
<i>Arceuthobium cyanocarpum</i>	Limber pine	Colorado	Limber pine dwarf mistletoe continued as a minor problem in Colorado.
<i>Arceuthobium douglasii</i>	Douglas-fir	Colorado	Occurs mostly in the southern two-thirds of the State. Moderate to high levels of the disease were detected in forest stands near North Cochetopa Pass. No suppression projects were funded by FHM in 1993.
<i>Arceuthobium vaginatum</i> subsp. <i>cryptopodium</i>	Ponderosa pine	Colorado	Losses amount to 885,000 cu. ft. annually. Suppression projects emphasized tree removal and pruning of infected trees in developed recreation sites. The disease continued to be a factor affecting management on the San Isabel, San Juan, and Uncompahgre NF's, and on the Southern Ute Reservation in southern Colorado.
<i>Arceuthobium divaricatum</i>	Pinyon pine	Colorado	Pinyon pine dwarf mistletoe continued as a minor problem in western Colorado.

DISEASE	HOST	LOCATION	REMARKS
Fir broom rust <i>Melampsorella</i> <i>caryophyllacearum</i>	Subalpine fir	Colorado, Wyoming	This disease is common throughout the spruce/fir cover type in Colorado, where it causes only minor damage. Brooms are scattered on older subalpine fir in the Bighorn NF.
Fir trunk rot <i>Phellinus pini</i>	Subalpine fir	Wyoming	Decay and possible mortality due to this pathogen are present in old-growth subalpine fir on the Bighorn NF.
Kabatina tip blight <i>Kabatina juniperi</i>	Rocky Mountain juniper, Eastern redcedar	Kansas	Kabatina tip blight was very severe across the state.
Pine tip blight <i>Sphaeropsis elisii</i>	Austrian pine	Kansas	Damage continued to increase, especially in urban and recreational plantings.
Poplar shoot blight <i>Venturia macularis</i>	Aspen	Colorado	Common on aspen regeneration in many locations in Colorado.
Red ray rot <i>Dichomitus squalens</i>	Ponderosa pine	South Dakota	Heartwood decay is widespread in mature ponderosa pine on the Black Hills NF.
Red ring rot <i>Phellinus pini</i>	Subalpine fir	Wyoming	Heartwood decay due to this fungus appears to be common in mature fir stands on the Bighorn NF.
Spruce broom rust <i>Chrysomyxa</i> <i>arctostaphyli</i>	Blue spruce, White spruce, Engelmann spruce	Colorado, South Dakota	Common throughout the spruce/fir cover type in Colorado, where it causes only minor damage. Brooms scattered throughout spruce on the Black Hills NF.
Western gall rust <i>Endocronartium</i> <i>harknessii</i>	Lodgepole pine, Ponderosa pine	Colorado, Nebraska, South Dakota, Wyoming	Western gall rust is present at moderate to severe levels in lodgepole pine near the Norrie Colony on the White River NF in Colorado. There was no increase in activity during 1993 in Colorado. Damage levels continue to be moderate to severe on ponderosa pine in certain areas of Nebraska, South Dakota, and common on lodgepole pine in Wyoming.

DISEASE	HOST	LOCATION	REMARKS
White pine blister rust <i>Cronartium</i> <i>ribicola</i>	Limber pine	South Dakota, Wyoming	Branch mortality continued at several locations in the Bighorn and Shoshone NF's. The disease is present in a remote stand in the Black Hills of South Dakota.
CANKER DISEASES			
Botryodiplodia <i>Botryodiplodia</i> sp.	Juniper	Kansas	The canker was very severe on Rocky Mountain juniper.
<i>Botryosphaeria</i> <i>stevensii</i>	Eastern redcedar, Rocky Mtn. juniper	Kansas, Nebraska	No significant activity reported in 1993.
Cytospora canker <i>Cytospora</i> spp.	Aspen, Poplar, Cottonwood, Willow, Mulberry	Colorado, South Dakota	This disease is common on aspen throughout Colorado where it is a management concern in recreation and regeneration areas. In the Gunnison Service Center zone in 1993, stands affected by the disease were noted on the Gunnison, Uncompahgre, San Isabel, San Juan, and Rio Grand NF's and at the Crested Butte and Aspen Mountain ski areas. Detailed surveys identified the disease in many campgrounds in the Telluride area. In urban communities, lombardy poplars continue to die from this disease 10-20 years after planting. Widespread on many other hosts, probably as a result of the October 1991 freeze and other stresses such as the mild, dry winter of 1991-92. It is widespread on aspen in the Black Hills, generally on trees weakened by other diseases and/or insects. The cankers continue to be a problem on trees under stress.
Cryptosphaeria canker <i>Cryptosphaeria populina</i>	Aspen	Colorado South Dakota	This organism continues to cause patch mortality of aspen in the Black Hills NF. In the Gunnison Service Center zone, detailed surveys identified the disease in many campgrounds and day use areas in the Telluride area. The disease also has been noted in various locations on the Gunnison National Forest.

Rocky Mountain Region-Status of Disease in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

DISEASE	HOST	LOCATION	REMARKS
Grovesiella canker <i>Grovesiella abietina</i>	Subalpine fir	Wyoming	Reported for the first time, this canker was causing mortality of leaders and branches of young sub-alpine fir in the understory. It was not causing mortality of young trees, but may be slowing their growth.
Russian olive canker <i>Phomopsis</i> sp., <i>Tubercularia</i> sp. or <i>Lasiodiplodia</i> sp.	Russian olive	Kansas, Nebraska, South Dakota, Wyoming	Continues to be a very serious problem in eastern half of Kansas. The lowest number of reports in years in South Dakota.
Siberian elm canker <i>Botryodiplodia hypoderma</i> , <i>Tubercularia ulmea</i>	Siberian elm	Colorado, Nebraska, South Dakota, Wyoming	Status not noted to be different than reported in 1992.
Sooty bark canker <i>Encoelia pruinosa</i>	Aspen	Colorado	Sooty bark canker is a common disease in aspen stands throughout Colorado. Detailed surveys identified the disease in many campgrounds and day-use areas in the Telluride area.
Thyronectria canker <i>Thyronectria</i> <i>austro-americana</i>	Honeylocust	Colorado, Kansas	Shade trees in Colorado were affected in large numbers in 1993, probably as a result of previously weakened condition. Windbreaks in western Kansas continued to be infected.
ROOT DISEASES			
Annosus root disease <i>Heterobasidion annosum</i>	Ponderosa pine, White fir Jack pine	Colorado, Nebraska	The disease was reported as a factor affecting management of mixed conifer stands on the Southern Ute Reservation and in white fir in the Amphitheater Campground on the Uncompahgre NF. Detailed assessments of annosus root disease impacts were carried out in the mixed conifer stands on the Southern Ute Reservation.

DISEASE	HOST	LOCATION	REMARKS
Armillaria root disease <i>Armillaria</i> spp.	Engelmann spruce, Lodgepole pine, Ponderosa pine, Subalpine fir, White fir	Colorado, South Dakota, Wyoming	This root disease continues to cause mortality of Black Hills spruce and ponderosa pine on the Black Hills NF. Surveys conducted in 1993 indicated that more than 18% of the northern and central Black Hills were occupied by disease centers; whereas, disease occurrence was negligible in the southern Black Hills. <i>Armillaria</i> root disease is affecting management of mixed conifer stands on the Southern Ute Reservation and is present in the spruce/fir stands at the Truby Complex Timber Sale areas on the San Juan NF and near Priest Lake on the Uncompahgre NF. The disease is also a major problem in the spruce/fir leave strips at the Aspen Mountain ski area and is killing scattered firs in similar leave strips at the Crested Butte Mountain Resort ski areas. Detailed assessments of <i>Armillaria</i> root disease impacts were carried out in: (1) lodgepole pine stands on the Alpine Plateau (west of Gunnison), and near Horseshoe Campground and Buckhorn Creek on the Arapaho and Roosevelt NF's; (2) in mixed conifer stands on the Southern Ute Reservation; (3) in ponderosa pine and white spruce stands in the Black Hills NF; and (4) in the spruce/fir leave strips at the Crested Butte ski area (Gunnison NF).
Leptographium root disease <i>Leptographium terebrantis</i>	Jack pine	Nebraska, South Dakota	This disease is the cause of high mortality of young jack pine regeneration in patch clearcuts and mature trees on the Bessey Ranger District of the Nebraska NF. The disease is known to be vectored by <i>Dendroctonus valens</i> (red turpentine beetle) and <i>Hylastes</i> sp. root feeding beetles. This pathogen also has been identified for the first time to be the cause of mortality of ponderosa pine regeneration in a thinned stand on the Black Hills NF.

DISEASE	HOST	LOCATION	REMARKS
Black stain root disease <i>Leptographium wageneri</i>	Pinyon pine, Ponderosa pine	Colorado	Continues to occur on ponderosa pine in interior portions of Colorado and on pinyon pine in the southwestern corner of the state. The disease is of major concern in recreation areas near McPhee Reservoir and at Mesa Verde National Park.
White mottled rot <i>Ganoderma applanatum</i>	Aspen	Colorado	Detailed surveys identified the disease as a source of potential hazard in several campgrounds and day-use areas in the Telluride Skyway area of the Uncompahgre NF.
FOLIAGE DISEASES			
Anthracnose <i>Gnomonia leptostyla</i>	Walnut	Kansas	No activity reported in 1993.
<i>Apiognomonina veneta</i> (= <i>Gnomonia platani</i>)	Sycamore	Colorado, Kansas, Wyoming	No activity reported in 1993.
Ash leaf rust <i>Puccinia sparganioides</i>	Green ash	Colorado, Kansas, Nebraska, South Dakota	No activity reported in 1993. Found on river bottom green ash near Julesburg, Colorado.
Brown spot needle blight <i>Scirrhia acicola</i>	Scotch pine	Kansas, Nebraska	Brown spot was reported to be moderate to severe in the eastern part of Kansas.
Cedar apple rust <i>Gymnosporangium juniperi-virginianae</i>	Apple species, Eastern redcedar	Colorado, Kansas, Nebraska, South Dakota, Wyoming	No activity reported in 1993.
<i>Gymnosporangium nelsonii</i>	Serviceberry, Juniper	Colorado	Locally common along recreation sites adjacent to the Poudre River in northern Colorado.

Rocky Mountain Region-Status of Disease in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

DISEASE	HOST	LOCATION	REMARKS
Cercospora blight of juniper <i>Cercospora sequoiae</i>	Eastern redcedar, Rocky Mt. juniper	Kansas, Nebraska, South Dakota	Cercospora was severe on Rocky Mountain juniper in eastern Kansas.
Conifer-aspen rust <i>Melampsora medusae</i>	Aspen, Douglas-fir, Ponderosa pine, Lodgepole pine	Colorado, South Dakota	Like the aspen foliage diseases conifer-aspen rust causes great aesthetic concern but little permanent damage to the host trees. In 1993, disease levels were low.
Diplodia blight <i>Sphaeropsis sapinea</i> (= <i>Diplodia pinea</i>)	Ponderosa pine	Nebraska, South Dakota	Damage levels did not appear to increase in 1993 in South Dakota; however, over 17,000 acres were heavily affected in western Nebraska.
Dothistroma needle blight <i>Scirrhia pini</i>	Austrian pine	Kansas, Nebraska	Dothistroma needle blight was moderate to severe in eastern Kansas.
Elytroderma needle cast <i>Elytroderma deformans</i>	Ponderosa pine	South Dakota	Continues to be found in low levels in the Black Hills NF.
Fire blight <i>Erwinia amylovora</i>	Apple species, Cotoneaster, Crabapple	Colorado, South Dakota, Wyoming	Activity always present in Colorado at some level.
Ink spot <i>Ciborina whetzellii</i>	Aspen	Colorado	Found throughout the aspen type, the disease creates great aesthetic concern. In 1993, incidence of the disease was low throughout Colorado.
Leaf shothole <i>Cylindrosporium</i> sp.	Black cherry, Chokecherry	Nebraska, South Dakota	No activity reported in 1993.
Marssonina blight <i>Marssonina populi</i>	Aspen	Colorado, South Dakota	Widespread on the Routt NF in north-western Colorado due to abnormally cool, wet weather.
Needle casts <i>Lophodermella concolor</i> <i>Lophodermella montivaga</i>	Lodgepole pine	Colorado, Wyoming	Noted in northcentral Colorado. Extensive discoloration of lodgepole pine occurred in the southern Bighorn Mountains of Wyoming. Damage was especially severe on young regeneration in clearcut areas.

Rocky Mountain Region-Status of Disease in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

DISEASE	HOST	LOCATION	REMARKS
Phomopsis blight <i>Phomopsis juniperovora</i>	Eastern redcedar, Rocky Mtn. juniper	Nebraska, South Dakota	Heavy shelterbelt infestations in eastern South Dakota.
Phomopsis Canker of Russian olive <i>Phomopsis arnoldiae</i>	Russian olive	Kansas	Continues to be a very serious problem in the eastern half of Kansas.
Septoria leaf spot <i>Septoria caraganae</i>	Caragana	South Dakota	No activity reported in 1993.
VASCULAR WILTS AND DECLINES			
Ash decline	Green ash	Colorado	No activity reported in 1993.
Dutch elm disease <i>Ceratocystis ulmi</i>	Elm species	Colorado, Kansas	Incidence was up slightly in 1993, as a result of the freeze damage of October 1991. There was a large in- crease in trunk attacks due to the 1991 freeze increasing declining trees in the Colorado Springs area. Dutch elm disease was confirmed from two Regal elms collected from the Colorado Springs nursery. Dutch elm disease is still a serious problem in many Kansas urban areas. Re- ports of the disease were about the same as 1992.
Oak wilt <i>Ceratocystis fagacearum</i>	Oak species	Kansas, Nebraska	The disease continues to slowly spread in the eastern third of Kansas.
Pinewood nematode <i>Bursaphelenchus xylophilus</i>	Scotch pine, Austrian pine, White pine	Kansas, Nebraska	Confirmed diagnosis of infected trees has been reported in 27 counties. Reports of infected trees were fewer in 1993.
Verticillium wilt <i>Verticillium spp.</i>	Catalpa, Redbud, Maple, Russian olive	Kansas	Verticillium wilt was moderate in 1993.

DISEASE	HOST	LOCATION	REMARKS
ABIOTIC			
Chemical damage	Many hardwood species	Colorado, Kansas, Nebraska, South Dakota, Wyoming	Herbicide damage to windbreaks and other tree plantings continued to be a serious problem.
Cottonwood mortality	Cottonwood	Colorado	Locally severe loss of cottonwoods along the Poudre River near Ft. Collins, CO, as a result of re-routing of the river channel and decreased available water supply to roots.
Drought, other unknown agents	Dogwood, Black walnut, Blue spruce, Buffaloberry, Green ash, Pear, Ponderosa pine, Poplar, Russian olive, Siberian elm, Silver maple	Colorado, Nebraska, South Dakota, Wyoming	No significant activity reported in 1993.
Frost damage	Hardwoods	South Dakota	No significant activity reported in 1993.
High water	Ponderosa pine	Colorado, South Dakota	No significant activity reported in 1993 in Colorado. There was damage in South Dakota as a result of standing water or high water tables.
Winter injury	Hardwoods	Colorado, Wyoming	The effects of the October 1991 low temperatures are still being observed in eastern Colorado and southern Wyoming. Siberian elm was particularly affected. Other species included willows, poplars, and cherry trees.

DISEASE	HOST	LOCATION	REMARKS
OTHER			
Porcupine feeding	Ponderosa pine Limber pine	South Dakota, Wyoming	Porcupine feeding damage was observed in association with comandra blister rust stem cankers on ponderosa pine in the Black Hills NF, and feeding damage was also found to be extensive in patches of young regenerating pine stands. Feeding damage is heavy in association with white pine blister rust on limber pine in Wyoming.
Sprout dieback	Aspen	Colorado	Examples of regeneration failure and dieback may be found on the Grand Mesa, Uncompahgre, Gunnison, San Juan and Routt NF's. Snow damage, dry sites, wet sites, herbivore pressure, competing understory, soil evolution, and disease may be involved.
Squirrel damage	Hackberry, Honeylocust, Maples, Ponderosa pine, Russian olive, Siberian elm	South Dakota, Colorado	No significant activity reported in South Dakota in 1993. Damage consists of gnawing of cambium layer and dieback of branches.

PESTICIDE USE in REGION 2 in FY 93

Type of Pesticide	Chemical Used 1/	Target Pest	Units Treated /Acres
Fumigant	Dazomet	Nematodes Fusarium Brown Spot Needle Blight Damping-off	5
Fungicide	Benomyl	Phomopsis Scleroderris	39
	Bordeaux	Blight	2
	Chlorothalonil	Blight	13
	Dowfume	Fungus	9
	Syllit 65 W	Fungus	7
Herbicide	Balan	General weeds	1
	Bromacil/Diuron	General weeds	196
	Chlorosulfuron	Noxious weeds	12
	Dacthal	Nursery weeds	291
	Dicamba	Noxious weeds	451
	Glyphosate	Noxious weeds	413
	Oxyfluorfen	Nursery weeds	2
	Pathway	Noxious weeds	360
	Picloram	Noxious weeds	790
	Tebuthiuron	Range Improvement	78
	2,4-D	Noxious weeds	618
	2,4-D amine	Noxious weeds	495
	2,4-D/Clopyralid	Noxious weeds	70
	2,4-D/Curtail	Noxious weeds	192

	2,4-D/Dicamba	Noxious weeds	405
	2,4-D/Picloram	Noxious weeds	4,074
Insecticide	Carbaryl	Aphids Grasshoppers Leaf beetles MPB	757
	Coumaphos	Miscellaneous (Cattle) insects, ticks, lice & mites	15,800 2/
	Dimethoate	Tip Moths	17
Rodenticide	Zinc phosphide	Prairie dogs	4,567

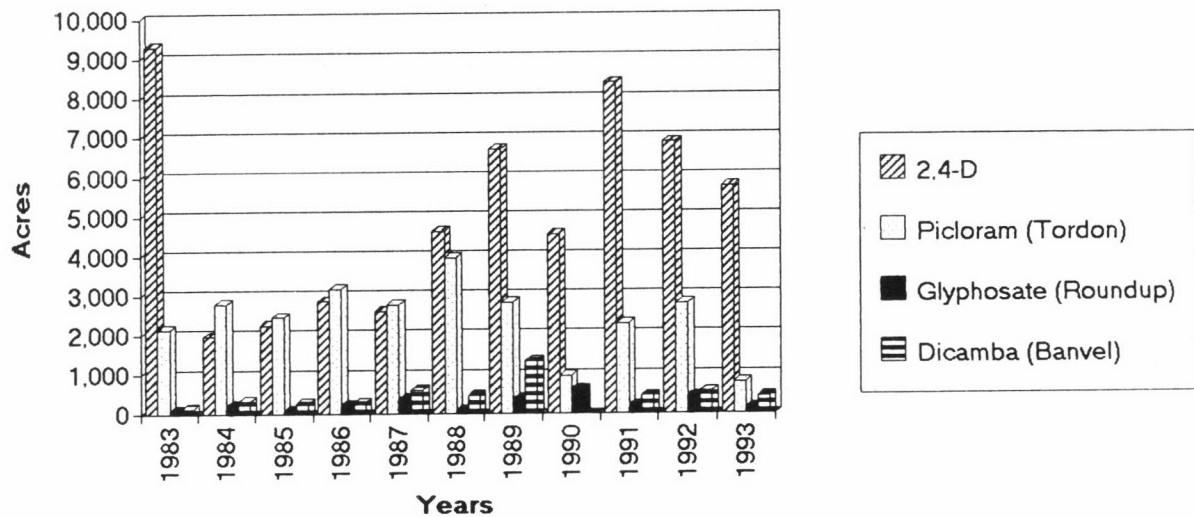
1/ Includes use by the USDA Forest Service, other federal agencies, permittees, licensees, and grantees.

2/ Number of animals

HERBICIDE USE IN REGION 2

While our knowledge of biological control is developing, the use of herbicides continues as an essential part of Forest Health Management. Herbicides are valuable tools in management of noxious weeds and undesirable vegetation in range management and in forest tree nursery management. The following graph shows herbicide use trends for the past 11 years. The major target species in the graph are the sagebrushes, thistles, leafy spurge, and various broadleaf weeds for range improvement and roadside management projects.

Herbicide Use in Region 2



FEDERAL CERTIFIED APPLICATOR REPORT

USDA FOREST SERVICE FEDERAL CERTIFIED APPLICATOR REPORT (REFS. FSM 2150 AND FSH 2109.11) (INSTRUCTIONS ON REVERSE SIDE) (REPORT FS-2100-L)			ADMINISTRATIVE UNIT	
			NATIONAL FOREST LANDS	
			REGION 2	
			FY-93	DATE
				11/22/93
CATEGORY	(1) TOTAL NUMBER CERTIFIED LAST REPORT	(2) NUMBER CERTIFIED THIS FY	(3) REVOKED/ SUSPENDED CERTIFICATIONS THIS FY	(4) TOTAL CERTIFIED END OF THIS FY
(4) AGRICULTURAL	54	45	1	76
(5) FOREST	17	7	5	17
(6) ORNAMENTAL AND TURF	1	1	0	1
(7) SEED TREATMENT	0	0	0	0
(8) AQUATIC	1	1	0	2
(9) RIGHT-OF-WAY	47	30	2	51
(10) INDUSTRIAL	1	0	0	1
(11) RESEARCH	0	1	0	1
(12) NUMBER OF EMPLOYEES CERTIFIED	64	53	3	82
PREVIOUS EDITION IS OBSOLETE			FS-2100-4 (9/84)	

RECENT PUBLICATIONS

(as of April 1994)

Angwin, P.A. and E.M. Hansen. 1993. Pairing tests to determine mating compatability in *Phellinus weirii*. Mycol. Res. 97:1469-1475.

Forest Health Management Group, W.H. Blunt, ed. 1993. Forest Insect and Disease Conditions in the Rocky Mountain Region 1992. USDA For. Serv., Renewable Resources, Rocky Mountain Region, Forest Health Mgmt. 50 p.

Hawksworth, F.G. and D.W. Johnson. 1993. You can save your trees from dwarf mistletoe. USDA For. Serv., Rocky Mountain Forest and Range Exp. Sta. GTR RM-225. 11 p.

Holah, J.C. 1993. A new insect-fungal complex of jack pine at Bessey Ranger District, Nebraska National Forest. USDA For. Serv., Renewable Resources, Rocky Mountain Region Biol. Eval. RCSC-93-01. 6 p.

Holah, J.C. 1993. Armillaria root disease and affected acreage of three ranger districts on the Black Hills National Forest. USDA For. Serv., Renewable Resources, Rocky Mountain Region Tech. Rep. R2-55. 13 p.

Lundquist, J.E. 1993. Distribution and causes of canopy gaps in white spruce in the Black Hills. USDA For. Serv., Rocky Mountain Forest and Range Exp. Sta. Research Note RM-520. 3 p.

Lundquist, J.E. 1993. Large scale spatial patterns of conifer diseases in the Bighorn Mountains, Wyoming. USDA For. Serv., Rocky Mountain Forest and Range Exp. Sta. Research Note RM-523. 8 p.

O'Neil, C.G. 1993. Forest Pest Conditions in the Rocky Mountain Region 1991. USDA For. Serv., Renewable Resources, Rocky Mountain Region, Forest Health Mgmt. 31 p.

Pasek, J.E. 1992. Incorporating pest information into forest planning: personal experience from the Black Hills, pp. 100-108. *In*: Proceedings of the fortieth annual Western International Forest Disease Work Conference, July 13-17, 1992, Durango, CO. 182 p.

Raimo, B.J. 1993. Western spruce budworm - Creede and Del Norte Districts, Rio Grande National Forest. USDA For. Serv., Renewable Resources, Rocky Mountain Region Biol. Eval. R2-92-4. 32 p.

Schaupp, W.C., Jr. 1993. Emergence and overwintering brood of Douglas-fir beetle four years after the Clover Mist Fire on the Clarks Fork Ranger District, Shoshone National Forest, Wyoming. USDA For. Serv., Renewable Resources, Rocky Mountain Region Biol. Eval. RCSC-94-01. 14 p.

Schaupp, W.C., Jr., J.E. Pasek, J.M. Schmid, S.A. Mata, and C.K. Lister. 1993. Mountain pine beetle emergence from infested logs during hauling. USDA For. Serv., Rocky Mountain Forest and Range Exp. Sta. Research Note RM-522. 4 p.

Sharon, E.M. 1993. Limitations to hazard tree assessment. Arbor Age 13:10-12.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. No official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable is intended.

*U.S. GOVERNMENT PRINTING OFFICE:1994-576-810/05154

UNIVERSITY OF MINNESOTA



3 1951 D01 190 335 R